Green Growth in North Macedonia's Agriculture Sector

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ABBREVIATIONS AND ACRONYMS

AKIS	Agriculture Knowledge and Information System
BISS	Basic Income Support for Sustainability
bcTE	Bias Corrected Technical Efficiency
CAP	Common Agricultural Policy
CRS	Constant Returns to Scale
CBD	Convention on Biological Diversity
DEA	Data Envelopment Analysis
EC	European Commission
EGD	European Green Deal
EU	European Union
FADN	Farm Accountancy Data Network
FNVA	Farm Net Value Added
F2F	Farm to Fork (F2F) Strategy
GPS	Global Positioning Systems
GAEC	Good Agricultural and Environmental Conditions
GHG	Greenhouse Gas
ICT	Information and Communications Technology
IARNM	Institute of Accreditation of the Republic of North Macedonia
IPA	Instrument for Pre-Accession
IPARD	Instrument for Pre-accession Assistance for Rural Development
IUCN	International Union for Conservation of Nature
MAFWE	Ministry of Agriculture, Forestry, and Water Economy
MEPP	Ministry of Environment and Physical Planning
NARDS	National Agriculture and Rural Development Strategies
NBSAP	National Biodiversity Strategy and Action Plan
NCCCC	National Climate Change Committee
NEA	National Extension Agency
NOBP	National Operational Broadband Plan
NDC	Nationally Determined Contribution
NGA	Next Generation Access
MAKSTAT	North Macedonia State Statistical Office
PaMs	Policies and Measures
R&D	Research and Development
RDP	Rural Development Program
SE	Scale Efficiency
SMEs	Small and Medium-Sized Enterprises
SMR	Statutory Management Requirements
TE	Technical Efficiency
UAA	Utilized Agriculture Area
VRS	Variable Returns to Scale

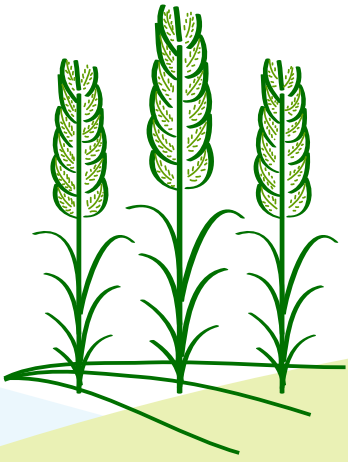
EXECUTIVE SUMMARY

This report focuses on the agri-food sector in North Macedonia and investigates the potential and necessary actions for adopting a green growth trajectory. Agri-food is a key sector in need of transformation to achieve green growth in the country. The sector has great economic importance, and it is vulnerable to climate change and other environmental risks, which will compound current sector inefficiencies, including declining competitiveness. This report aims to assess: (i) the actions needed to re-focus agricultural support priorities in a manner that reflects green growth ambitions; (ii) policy financing implications; and (iii) the availability and capacity of effective policy implementation mechanisms. Finally, the potential impacts of greening agriculture support on farm efficiency are assessed and discussed.

The Context

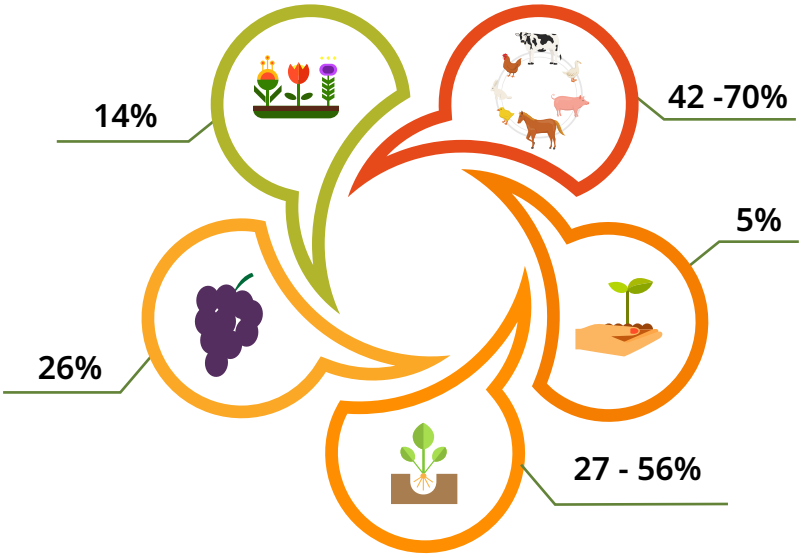
In the context of green growth, agriculture in North Macedonia is currently inefficient. Agricultural systems are poorly adapted to current climate conditions, and sectoral inefficiencies are expected to be exacerbated by future climate change. Problems include limited water availability and inadequate irrigation that hinders productivity, which will be aggravated by climate change. Water pollution risks are high in intensive agricultural regions, and soil fertility problems include erosion, soil-born pests and diseases, soil pollution caused by the unsustainable use of agrochemicals and the inappropriate use of irrigation water, and a rapid decline of organic soil matter and salinization. Soil erosion results in reduced yields and produces sediment that pollutes waterways. Biodiversity also faces degradation problems due to land abandonment. Small parcel sizes are a serious obstacle to the implementation of agri-environment or adaptation measures. Further, primary producers have a limited capacity to adapt due to their financial and know-how constraints. These problems have persisted despite the efforts of several National Agriculture and Rural Development Strategies (NARDS) to promote a sustainable agriculture model.

Public support for agriculture in North Macedonia has been generous. Between 2017 and 2020, budgetary transfers to farmers represented 1.19 percent of GDP-double that of other Western Balkan countries and almost 60 percent higher than the European Union (EU) average. Direct farm subsidies amounted to 1.10 percent of GDP in 2017-2020, which is more than three times the EU average. Market support and direct payments represented 81.3 percent of agriculture budget outlays. Around 62 percent of this support benefitted crops and favored low value production. Rural development accounted for 10.6 percent of total support. In contrast to the 2010-2016 period, when support focused on farm competitiveness, in 2017-2020 the rural development envelope focused on rural diversification (44 percent of rural development expenditure), while farm competitiveness (31 percent) and environment and natural resources (25 percent) also commanded significant shares. Food safety and veterinary



services accounted for 7.2 percent of total agriculture policy support spending, while expenditure on farm extension services was rather low (0.9 percent).

Agricultural support structures are slowly evolving in the country, while the structure of public spending on agriculture has raised questions regarding its overall effectiveness and capacity to facilitate structural adjustment. Direct payments schemes are complex and coupled to production, with limited application of cross-compliance rules. The use of subsidies is high with direct payments representing 34.3 percent of farm net value added, which is much higher than the EU average of 27.2 percent. Subsidy intensity increases according to the economic size of the farm, ranging from 27 percent of farm net value added for very small farms to 56 percent for large ones. Subsidies also vary by agricultural sub-sector, ranging from 42 percent to 70 percent for milk, sheep, and goat producers; 26 percent for viniculture; 14 percent for perennial crops; and 5 percent for horticulture.



Considerable efforts are needed to improve policy design and delivery in domains that are relevant to green growth. Institutions lack human resources, coordination and inter-sectoral cooperation are problematic, and financial resources are insufficient. However, strategic choices for the 2021-2027 agricultural and rural development policy are aligned with the new Common Agricultural Policy (CAP) and in principle, respond to the sector's challenges. The 2021-2027 NARDS fully adopts the 2023-2027 CAP framework. It includes a commitment for a gradual adoption of decoupled support and schemes foreseen in the 2023-2027 CAP. It foresees a flat rate of Basic Income Support for Sustainability (BISS) and adherence to cross-compliance requirements. However, NARDS also foresees a rather extensive program of coupled support that targets several agricultural sub-sectors, including cereals, which are crucial for food safety; tobacco; meat and milk; wine grapes; and fruits and vegetables.

Rural development action prioritizes environmental protection, conservation of natural resources, and adaptation and mitigation of climate change effects and introduces a risk management instrument and measures on knowledge and information transfer. Also,

NARDS foresees improvements in the institutional capacity of the National Extension Agency (NEA), while advisory services are planned to facilitate the transfer of information on new technology and innovation. Further, there are plans to support the agriculture sector's digital transition and to strengthen links between the Agriculture Knowledge and Information System (AKIS), digitization and advisory services, while mandatory training and education will aim to improve capacity in agriculture. Several actions are also foreseen to improve food safety and veterinary health systems. Last, but not least, specific actions aim to improve institutional capacity and information and communications technology (ICT) systems for strategy implementation, to upgrade Ministry of Agriculture, Forestry, and Water Economy (MAFWE) staff competencies, and to develop a modern Agriculture Information System for policy monitoring and evaluation.

The 2021-2027 NARDS foresees a significant restructuring of public support on agriculture and rural development. The direct payments envelope will slightly decrease (by around 6 percent) compared to 2017-2020 annual average levels, while average annual spending on rural development is projected to record a fourfold increase. Complementarity between investments supported by both the National Program and the Instrument for Pre-accession Assistance for Rural Development (IPARD) III programme is pursued through clear demarcation criteria.

North Macedonia vis-à-vis European Green Deal Targets

Despite lagging behind in some European Green Deal (EGD) targets, North Macedonia seems to be doing better than the EU-27 in others. The country has a more convergent trajectory than the EU-27 on targets such as fertilizer use, pesticides use, broadband coverage in rural areas and greenhouse gas (GHG) emissions. However, the EU-27 converge better towards EGD targets on organic farming area, high diversity landscape features and protected areas. Even in the case of EGD targets for which North Macedonia outperforms the EU-27, it seems that a considerable distance exists between the status quo in North Macedonia and EGD target values for 2030.

Organic farming in North Macedonia has been evolving very slowly**.** In 2019, there were only 847 farm holdings (0.48 percent of total farms in the country) certified as organic, or in transition. Only 1,881 ha of land are fully converted to organic (0.36 percent of utilized agriculture area [UAA]), and 1,372 ha were in transition. Organic crop production is currently dominated by fodder, cereals, orchards, aromatic and medicinal plants, and horticulture. In parallel, there has been an increased interest in raising organic cattle, sheep, goats, and beehives. The supply of processed organic products is almost insignificant and there are limited linkages between organic farmers and processors.

The legislation, competent authority, control bodies, and accreditation system for organic farming are established and operational. However, monitoring and control of organic certification and products need to be carried out

more systematically. Public support for organic farming in 2014-2020 was set at 30 percent of direct payments granted. Support rates are planned to increase in 2021-2027; however, the new rates fall short of EU average support rates for organic farming, which account for nearly 84 percent of direct payments. This indicates that under-compensation for converting to organic has been one of the reasons for the slow development of organic farming in North Macedonia.

Structural constraints characterizing agriculture in North Macedonia seem to also explain the poor uptake of organic farming. These include limited entrepreneurial skills, financial capacity, and the technical know-how of producers. Liquidity for investments and innovation are low and state extension services lack capacity, as advisors are not trained on the specificities of organic farming. Very few farmers have agricultural training or education in nature conservation and have difficulties in meeting organic farming requirements. MAFWE capacity is low with very few staff members able to deal with organic agriculture.

Policy initiatives should focus on the removal of barriers and the creation of an enabling environment for the development of organic farming. Building farmers' capacities by providing them with various forms of technical and administrative assistance can increase farmers' participation in organic agriculture. Strengthening social and human capital to ensure a smooth and large-scale uptake of agri-environment measures requires understanding and cooperation between relevant stakeholders, a constant exchange of information, and capacity building. Coordinating policy measures on organic farming, advisory services, and the improvement of skills and competencies would improve the professional expertise and knowledge of recipients related to organic farming practices, while synchronization with farm investment support and the AKIS system would facilitate the sector's modernization.

The accreditation of the measure for organic production supported by the IPARD III program is of paramount importance. Resources for supporting organic farming should be considerably increased and the current national targets streamlined with EGD goals. Assuming a 15 percent target for the country's UAA under organic farming and a rate of support of 70 percent of direct payments, it is estimated that some MKD 730 million (about USD 13 million) per year would be required for organic farming support. This amount corresponds to 15 percent of the rural development envelope for 2021-2027 and is considered realistic.

The dominant characteristic of *high diversity agricultural landscapes* in North Macedonia is low-intensity land use. Threats to agricultural landscapes include the abandonment of both traditional livestock breeding practices and traditional agricultural practices. In recent years, the biggest threat to the diversity of agricultural landscapes in the country has been the large number of pastures and meadows that are lost to land abandonment and the cessation of traditional farming practices. An ageing rural population with low incomes and poor infrastructure are also factors contributing to land abandonment and the deterioration of semi-natural grassland habitats and traditional landscapes.

Public policy has attempted to drum up support for agricultural landscape diversity in North Macedonia, but success has been limited. The Ministry of Environment and Physical Planning (MEPP) and MAFWE have tried to protect landscape diversity in the country

through various measures and activities. However, there is a lack of coordination and integration of relevant policy initiatives and responsible institutional structures are short of personnel. Also, the monitoring of policy impacts on agricultural landscape diversity is non-existent.

The use of mineral fertilizers and pesticides in the country has been low (compared to the EU) and is decreasing, but inefficient application seems to be the main problem. From an environmental perspective, the core issue does not relate to the quantities used, but to the frequency, timing, appropriateness, and quality of mineral fertilizers and pesticides.

The use of pesticides and mineral fertilizers in North Macedonia is rarely based on expert information.

Administrative capacity remains weak and there is no systematic provision of advice, monitoring, or analysis. Only 5 percent to 10 percent of farms in the country document their fertilizer and pesticide use. Despite the availability of Good Agricultural and Environmental Conditions (GAEC) and a rulebook for good agricultural practices on fertilizer use, most holdings apply fertilizer without soil analysis. Also, most farmers are guided by input suppliers on the use of pesticides. The capacity of the advisory system leaves a lot to be desired. Inspections are only conducted on a small percentage of large farms.

Agri-environment measures have been applied but financial outlays are low and monitoring is non-existent. Strategic policy initiatives for 2021-2027 seem to be heading in the right direction. IPARD III includes areas such as the sustainable management of farm inputs, including integrated production, organic farming, and manure management, among others. A farm investment measure includes action for environmental protection including fertilizer use, and there are plans to offer advice to farmers on the use of fertilizers and pesticides. IPARD III and the National Program for support to agriculture and rural development aim to support the sustainable use of fertilizers and pesticides also through operational programs for producer organizations and the AKIS, through tailored advice and training, while the National Action Plan on Climate Change foresees the reduction of fertilizer input, through enhanced agriculture practices and technology adoption.

A further reduction of fertilizer and pesticide use and a convergence toward EGD targets seems feasible, especially if there are improvements in application efficiency, triggered by an upgrade of farm advisory services, use of soil maps and digital technology, and contract farming (which promotes traceability). Wheat (due to its large share in total cultivated area), maize, vineyards, and fruit orchards (due to their high rates of fertilization per ha) account for 58.2 percent of fertilizer consumption in the country. If horticulture crops are added, these five crops account for 82 percent of total fertilizer use in North Macedonia. A 10 percent reduction in fertilizer use per ha for these crops would decrease national

fertilizer use by 8 percent. Alternatively, lower support and more effective agro-technical practices could be considered for low-value crops such as wheat and maize, which together account for nearly 41 percent of fertilizer use. However, the recent food security implications of the war in Ukraine do not currently promote this option. Finally, decreasing pesticide use in high-value crops such as vines, fruits, and vegetables should be pursued.

North Macedonia has been making steady progress with its *broadband infrastructure development*. In recent years, the country has improved its legal and regulatory framework, enabling private sector investments in infrastructure. According to the National Operational Broadband Plan (NOBP) implementation report, fixed broadband coverage was at nearly 98 percent in 2020, higher than the EU average of 97 percent, while take-up was at 73 percent (78 percent in the EU). However, mobile broadband penetration was at 65 percent (100 percent in the EU), and ultra-fast broadband take-up at 27 percent (41 percent in the EU). Rural broadband coverage has advanced in recent years, with almost 70 percent of rural households using broadband, compared to 25 percent in 2011.

Broadband use remains uneven in rural areas in North Macedonia. Market failures have led to underinvestment in broadband infrastructure in depopulated rural areas, resulting in considerable regional access disparities. In fact, 30 percent of (mostly rural) households are in "white zones", which lack access to super/ultra-fast Internet. High prices for telecommunications and low purchasing power have slowed the adoption of high-speed broadband connections and have widened the digital divide between low - and high-income households. The non - competitive structure of both retail and wholesale ICT markets in the country also contributes to low uptake.

North Macedonia lacks a coherent policy framework to directly support private sector ICT adoption. There have been tax incentives for purchasing software and hardware, but not enough to support the private sector adoption of ICT. Even though ICT is one of the fastest growing sectors, the absorption of technology by small and medium-sized enterprises (SMEs) remains low. Further, skill shortages constrain the development of the ICT sector, as skilled staff are attracted by multinationals or move abroad.

There seems to be a good basis for the introduction of digital technologies in agriculture in North Macedonia, but higher capacity should be built. Farmers have significant know-how when it comes to using ICT devices such as smartphones, computers, and the internet. However, they have little knowledge on more advanced ICT technologies, such as automated systems, global positioning systems (GPS), and other tools for precision agriculture. In addition, farmers have limited awareness of the impact of smartphones on agribusiness, even though the devices are widely used in rural areas. Capacity building support is needed to ensure a digital ecosystem that supports this sector.

North Macedonia authorities should develop a modern and inclusive broadband network in the country. A coherent regulatory framework for the broadband market should aim to promote investment without undue barriers, such as high taxation or high charges for

access to government-managed infrastructure, such as spectrum. Policy initiatives should improve conditions for private sector investment to expand high-speed broadband access to under-served areas, improve international competitiveness, create job opportunities, and promote social inclusion and territorial cohesion. Enhancing competition could reduce prices and speed the adoption of broadband connections. Cooperative models involving network and infrastructure-sharing and joint cost ventures could be introduced to promote market effectiveness.

A comprehensive approach is necessary to support agricultural and rural digitalization. Successful efforts to expand rural broadband coverage should continue and policy initiatives on firms' ICT adoption and skills upgrading should be distinct for rural areas. The adoption of precision farming should be supported to more efficiently use resources. This would contribute to an upgrade in the sector's economic and environmental performance. Similarly, the digitalization of the agri - food chain would improve performance through technology which would improve the transparency and traceability of quality standards. Digital technologies should be used to support AKIS, knowledge exchange, training, and advisory services.

North Macedonia has been moderately active in the development and management of *protected areas*. Protected areas cover about 9 percent of the country's territory. Progress in protected area reclamation has been slow—the share of designated areas in the overall area of the country went from 7.14 percent in 1990 to 8.94 percent in 2017.

Nature conservation policies are centralized within government institutions. MEPP is the main institution and is responsible for the development of policies and provision of technical expertise on legislation and is in charge of policy implementation on biodiversity, protected areas, and natural heritage. The National Committee for Biological Diversity monitors the implementation of the Convention on Biological Diversity. Also, MAFWE has an important role through its functions on forest protection, fishing, hunting, organic farming, agro-biological diversity protection, rural development, and plant and animal protection. Public institutions (at the local level) have been appointed to manage protected areas.

The country's network of protected areas is not coherent, and does not ensure ecological continuity and connectivity because the linking of ecological corridors is still lacking. Delays in the process of revalorization and re-proclamation of existing protected areas impede the proper delineation of the areas, as well as the preparation and adoption of management plans. A land cadastre to allow the determination of land use and land ownership, and a national inventory of forest resources are lacking. However, there is progress on the identification of potential future sites of "Natura 2000"[1] and on the effective implementation of the EU Acquis in the field of nature protection.

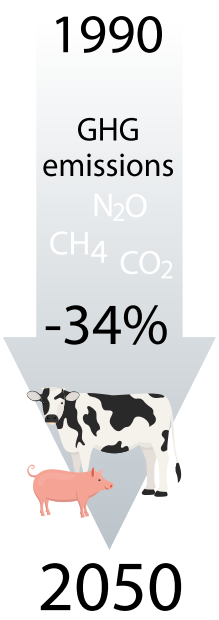
Institutional capacity and coordination are weak. The management authorities for protected areas lack

[1] https://ec.europa.eu/environment/nature/natura2000/index_en.htm

expertise and funding. The Department for Nature has limited capacity (currently, it has only 13 employees) and financial resources to implement relevant legislation and other tasks, such as planning, establishing, and supervising protected areas. MEPP and MAFWE have limited coordination and the monitoring of nature protection actions is poor.

The National Strategy for Nature Protection and Action Plan for 2017-2027 and the National Biodiversity Strategy and Action Plan for 2018-2023 have set new ambitions for protected areas in the country. However, harmonization is required between the two strategies, as well as concerted efforts to coordinate activities between the MEPP and other sectors, such as forestry, agriculture (including organic), transport, energy, and tourism. Data collection, monitoring, and analysis systems should be established in an integrated manner. Material and human resources should be upgraded at both the national and local levels. A distinct government budget line should allocate and earmark funds for the management of protected areas, and payments for ecosystem services in protected areas should be established to facilitate financial sustainability.

Finally, the Natura 2000 framework should be used to generate a coherent network of protected areas to reach the relevant EGD target. Considering the EU-accession prospects of the country and the current fragmentation of protected areas, pursuing coherence with Natura 2000 provisions could lead to a more comprehensive, effectively managed, and a viable system of protected areas in the country.



The share of agriculture in total GHG emissions in North Macedonia is 9.2 percent and has been declining. The majority (77.6 percent) of agriculture sector emissions are a consequence of livestock production activities, namely enteric fermentation, manure management, and manure left on pastures. Other notable sources include synthetic fertilizers and on-farm energy use. Compared to 1990, agriculture emissions in North Macedonia have decreased by 25.7 percent, mainly due to a decrease of livestock stock. On-farm energy use has recorded the sharpest decline (63.2 percent), followed by rice cultivation (54.4 percent), manure left on pastures (44.3 percent), and synthetic fertilizers (36.4 percent). The reduction of emissions associated with enteric fermentation (by 20.8 percent) was much lower. Emissions from manure management increased by 2.7 percent.

North Macedonia has been making progress on its commitments to reduce GHG emissions. The 2021 Long-Term Strategy on Climate Action committed to reduce GHG emissions by 42 percent by 2050, compared to 1990 levels. By the end of 2021, North Macedonia communicated an enhanced nationally determined contribution (NDC) to the global efforts for GHG emissions reduction, committing to a 51 percent reduction of GHG emissions by 2030, compared to 1990 levels. For agriculture, GHG emissions reduction targets of 29 percent and 34 percent are set for 2030 and 2050, respectively. This will be pursued through the adoption of various measures.

Such measures include a 3 percent reduction of CH_4 emissions from enteric fermentation

in dairy cows through the modification of feed content and nutrition management; a 20 percent reduction of N_2O emissions from manure management in dairy cows; a 13 percent reduction of N_2O emissions from manure management in swine farms; and a 20 percent reduction of N_2O emissions from manure in dairy cows for farms below 50 livestock units. Measures for other land uses include the conversion of land use for field crops above 15 percent inclination into perennial grassland; contour cultivation on areas under field crops on inclined terrains; perennial grass in orchards and vineyards on inclined terrains; use of biochar for carbon sink on agricultural land; and photovoltaic irrigation.

Financial commitments for these measures do not seem ambitious enough and their distribution does not seem cost-effective. In total, investment costs for measures aiming to reduce GHG emissions in agriculture will amount to EUR 102 million by 2040, to be financed by IPARD. This corresponds to a little less than the annual average budget for direct payments over 2021-2027. The cost effectiveness of policy measures varies significantly, with measures on livestock emissions being the most cost-effective. Only EUR 300,000 are allocated for the reduction of emissions from enteric fermentation, even though this is the most cost-effective measure and deals with the most important origin of agriculture emissions.

The implementation of climate change adaptation measures in agriculture is hindered by the sector's dependence on smallholders, the limited awareness of the effects of climate change among key actors, and insufficient support for farmers to cope with the negative impacts of climate change. However, perhaps the most important barriers are shortages in farm infrastructure investments, technology adoption, and technical capacity which would enable farmers to pursue adaptation actions. Institutional capacity is weak. While there is an inter-ministerial coordination mechanism on climate change, participating Ministries do not have units dedicated to climate change.

Policy initiatives to reduce agriculture emissions should be more ambitious. Projected climate risks justify higher reduction targets, a larger financial envelope, a re-examination of financial resources distribution among measures, and the prioritization of measures which are both targeted and cost-effective. Policy action supporting digital agriculture, energy efficiency, investments in climate resilient agriculture, and improving the resilience of farmers to climatic shocks through insurance, value-chain management, and technological advances should be prioritized. Also, the development of skill-building programs on sustainable technologies should be pursued.

Impacts of Green Practices on Farm Performance in North Macedonia

This section presents the main findings of an analysis on the efficiency of farms in North Macedonia. The analysis uses the most recently available (2018) individual-farm Farm Accountancy Data Network (FADN) national dataset, to estimate the current technical efficiency (TE) and scale efficiency (SE) performance of farms in the country and to assess the impacts of drivers associated with current production practices and the agriculture support mix. Subsequently, estimates are derived on farm performance differentials associated with the use of production methods with different levels of input intensity. In this way, the potential impacts of sustainable farming practices and greening agriculture support on farm efficiency are approximated.

The analysis is based on a multi-input, multi-output distance function, adopting non-parametric estimation techniques (Data Envelopment Analysis approach, correcting for bias). Farm heterogeneity specific to the study objectives is considered in efficiency estimations. Two distinct specifications are used to reflect different production sustainability orientations. First, the assessment considers the whole 2018 FADN sample, followed by estimates on a sub-group of low input-intensity farms, approximated through the European Commission Farm Input Intensity Context Indicator. Farm-type classifications are utilized, reflecting differences in economic size, subsidization status, production orientation, farm manager characteristics, and regional location.

The results show that farms in North Macedonia are characterized by technical inefficiency and polarization. The mean bias corrected score (bcTE) is low (0.441) indicating that the average farm in the sample can produce the same output using 66 percent fewer inputs, given the available production technology. The minimum value of bcTE is 0.111 (very inefficient) while the maximum is 0.842 (quite efficient), showing a polarization phenomenon. Around 57 percent of sampled farms are comparatively quite inefficient, with their bcTE score not exceeding 0.4 while about 24 percent perform quite well, exhibiting a high TE (over 0.6). In contrast, North Macedonia farms seem to exploit the potential of employed technology with the mean scale efficiency being considerably high (0.762).

Subsidized farms perform worse than non-subsidized ones. Farms receiving any type of subsidy have comparatively lower TE scores (bcTE: 0.434) than non-subsidized farms (bcTE: 0.525), with the larger differential observed for farms receiving subsidies for industrial crops (bcTE: 0.333 compared to 0.459). Rural development support for investments does not seem to be linked to any TE differentials between subsidized and non-subsidized farms. This shows that the adoption of new technologies using subsidy grants, may result, at least in the short run, in significant adjustment costs mainly attributed to the farm's organizational and human capital features. Policies that aim to reduce technology adoption adjustment costs may be valuable in such cases.

Medium-sized farms are the least technically efficient in North Macedonia, indicating a "missing middle" phenomenon. Micro farms exhibit superior productive performance in terms of TE. Large farms exhibit superior SE (0.886), while medium farms also perform well. Subsidies provided to medium and large-sized farms facilitate liquidity which in turn, enable better scale decisions. In contrast, micro farms, and to a lesser extent small farms, suffer SE losses due to scale inefficiencies. They are underinvested and do not exploit returns to scale as efficiently as their larger peers.

Full agricultural training is linked to higher productive performance, while farm managers' age is not, generating reservations on the effectiveness of the young farmers' scheme. Different output specialization does not seem to link to higher performance.

Farms characterized by low input-intensity seem to be more technically efficient compared to other farms in the country**.** On the other hand, high-intensity farms seem to be outperforming their peers in terms of SE (0.829), while low-intensity ones seem to be lagging (SE: 0.698). This finding is reasonable, as in contrast to low-intensity farms, a direct payments system favoring larger farmers provides them with the necessary cash flow, which in turn, enables better scale decisions.

When findings on both types of efficiency are combined, the importance of structural issues characterizing the sector in North Macedonia emerges. Micro and low-intensity farms seem to be under-utilized and record low SE scores. In other words, due to credit and other constraints, these farms are not able to benefit from returns to scale. In this respect, they exploit all their competences and capabilities from a managerial point of view to survive and hence, they show high TE scores. A comparatively high TE is their only way to survive. When farms grow to a certain size (i.e., medium) and/or become more intensive, they seem to become disorganized. It seems that constraints associated with management practices and structural difficulties (e.g., limited access to finance, technology, or markets) hinder their transformation to more efficient units. Basic skill acquisition programs do not facilitate an improvement in performance, as managers with basic training lag in efficiency. The same argument holds for rural development support for investments, at least in the short run, as adjustment to a new production structure often comes at the cost of lower efficiency. More importantly, the country's generous farm support program seems to provide the necessary "ammunition" for improvements in scale decisions; however, it does not facilitate improvements in managerial and organizational competence and production decisions and it may lead to resource misallocation.

The analysis of efficiency drivers partly confirms the findings of the differential analysis. For the whole sample, total subsidies seem to exert a slight positive influence on TE, while rural development support on investments negatively affects TE (-0.213). However, findings on the impact of rural development support on investments are susceptible to both the very short run and the productivity paradox. Subsidy intensity (total subsidies per ha of UAA) exerts a positive impact (0.162) on TE; however, this is up to a limit, as further growth in subsidy intensity seems to be negatively influencing TE (-0.014). An increase in economic size would likely lead to TE losses. However, when farm size exceeds a certain limit (that of medium farms), then it increases benefits on TE.

The provision of high subsidies to low input-intensity farms of a larger economic size negatively affects their productive performance. Findings show that subsidy intensity positively affects the TE of low-intensity farms; however, these positive effects become negative when both subsidies per ha and farm economic size exceed a certain threshold. In other words, for low-intensity farms, heavier subsidization per ha coupled with larger economic size generates diminishing marginal TE returns of subsidies. In contrast, a smaller amount of subsidy per ha directed towards smaller (in terms of economic size) farms, seems to benefit their productive performance.

Options Within a Greener Policy Strategic Approach

Policy recommendations drawn from this analysis that aim to facilitate the green transition of agri-food in North Macedonia correspond to both the short- and longer runs. In the short term, the government should ensure that the new policy approach and specific measures (especially with regard to direct payments) specified in the 2021-2027 NARDS are materialized. Knowledge transfer and advisory services should improve to facilitate efficiency gains associated with greener practices. This is especially important for the use of fertilizers and pesticides, where a mix of effective advice and controls are necessary. The same holds for organic farming to ensure that the relevant regulatory framework is properly applied.

Changes to the support mix associated with EGD targets also seem necessary in the short run. These include an increase in support rates for organic farming, a convergence of these rates towards EU-average levels, and a significant budget increase. GHG emissions reduction measures for agriculture should be restructured with an emphasis on reducing livestock emissions, especially from enteric fermentation.

In the longer term, to be effective, policy initiatives to facilitate the green transition of agri-food should be integrated into a new strategic approach. A review of the current agricultural policy mix indicates the need to repurpose agricultural policy support. This shift should be toward productivity-enhancing innovations, which also generate lower negative environmental impacts. Public goods (advisory services, training, agricultural infrastructure) should be provided to facilitate economic and environmental sustainability in the sector. The green transition of the agri-food sector can be promoted through policies that improve sector efficiency and promote sustainable practices. As shown by the findings of the econometric analysis, policy initiatives aiming to achieve efficiency gains could correspond to a "win-win" strategy for farmers' environmental and economic performance.

Better targeting of farm support is essential as higher subsidies seem to lead to the dependence of farm incomes on transfers and to farm intensification, without necessarily improving economic performance.

Policy should create strong incentives to favor changes in production systems and promote the de-intensification of production. Efficiency gains that lead to a greener production system will help create a more competitive and export-oriented agri-food sector in North Macedonia. Efficiency gains induced by a repurposed agri-food policy mix, which facilitates innovation at the farm level, would reduce the negative climatic and environmental impacts of agricultural practices and improve farms' economic performance in the longer term. For instance, the development of precision farming and broadband coverage would contribute to reduced pesticide and fertilizer use. Such innovations also have the potential to reduce variable production costs. However, they require investments on innovation adoption which can be materialized by the removal of barriers such as limited information and skills, constraints in public infrastructure and in credit supply, and uncertainty about the performance of new technology. Public support such as targeted investment aids, should be used to foster the adoption of innovation, which facilitates more sustainable practices.

Finally, institutional strengthening is important for the green transition of the agri-food sector in North Macedonia. The capacity of research and extension systems as well as of the public administration should be enhanced and should become climate-proof. Cooperation among scientific and educational bodies, extension and training services, and producers and processors should facilitate a transfer of innovative and environmentally friendly technology and farming methods, which at the same time, would facilitate economic performance. The systematic monitoring and evaluation of environmental and economic results and impacts would improve policy efficacy and legitimacy.

INTRODUCTION

1. **In an effort to tackle climate and environment-related challenges, the European Commission (EC) proposed the European Green Deal (EGD) in December 2019**. It was adopted in 2020 and constitutes a new growth strategy that aims to respond to urgent sustainability challenges and transform the European Union (EU) into "…a fair and prosperous society, with a modern, resource-efficient, and competitive economy…", which is firmly on a path of sustainable and inclusive growth (EC, 2019a). Alongside the ambition for climate neutrality in the EU, the EGD defines a series of key policies and measures for the efficient use of resources, promotes economic growth decoupled from resource use, restores biodiversity, and cuts pollution. In parallel, the EGD provides a framework for a just transition, through financial support and technical assistance to economic actors and regions in risk of being left behind.

2. **The European agri-food system is complex, diverse, has a major influence on the environment, and plays a special role in climate action.** The EGD aims to affect several dimensions of agriculture and food systems that are considered central to delivering environmental and climate goals in Europe. In fact, several EGD policy actions are relevant to agriculture and the agri-food sector. Specifically, the Farm to Fork (F2F) Strategy (EC, 2020a) is at the heart of the EGD, directly affecting the agri-food system and aiming to transform it so that it becomes fair, healthy, and environmentally friendly. However, other EGD policies also affect the agri-food sector, including those related to climate, biodiversity, and the circular economy. Hence, together with other EGD elements such as the EU Biodiversity Strategy (EC, 2020b), the Circular Economy Action Plan (EC, 2020c) and the 2030 Climate Target Plan (EC, 2020d), the F2F Strategy provides a key opportunity to align agriculture and food-related policies in a manner that supports sustainability efforts and contributes to the United Nations Sustainable Development Goals.

3. **Together with the Biodiversity Strategy, the F2F Strategy aims to directly affect EU agri-food systems, through the inclusion of targets for specific aspects**. Such targets include area under organic farming, pesticide risk and use, antimicrobial use, nutrient losses (occurring from the excessive use of fertilizers), high-diversity landscape features on agricultural land, and access to fast broadband in rural areas. Further, agriculture is expected to contribute to the 55 percent greenhouse gas (GHG) emissions reduction target by 2030[2] and to climate neutrality by 2050. EU Member States were guided to design Common Agricultural Policy (CAP) 2023-2027 instruments in a manner that fulfils the objectives of the CAP and the ambitions of the EGD through detailed, holistic, and integrated strategies (EC, 2020e; 2020f; European Parliament [EP], 2020; Marėchal *et al*., 2020).

4. **Agriculture in the Western Balkans is undergoing structural transformation.** Primary agriculture represents an important[3] but declining share in GDP, yet for most countries, the share of the primary sector in employment remains close to 20 percent. The region is rich in natural resources, but agri-food systems in Western Balkan countries face numerous challenges and remain constrained by deeply rooted

[2] Compared to 1990 levels.
[3] Around 10 percent.

structural problems: the average farm size is several times lower than in the EU, labor productivity and yields are very low due to underdeveloped technological capabilities, and many households are still engaged in subsistence agriculture. In general, the rural areas have not been very successful in the generation of off-farm jobs and rural migration is evident, especially for younger people.

5. **For the Western Balkans region, the adoption of the EGD implies a challenge in terms of assessing necessary policy action and the impacts of greening agricultural policy in a manner that promotes a green growth agenda**. As noted in the EGD Communication, the environmental ambition of the EGD cannot be achieved by the EU acting alone. In that sense, the EU aims to use its influence, expertise, and financial resources to mobilize its neighbors and partners to join a sustainable path (EC, 2019a). This goal seems particularly valid for the Western Balkan countries that also have EU-accession ambitions.[4] In fact, the EC's Economic and Investment Plan for the Western Balkans (EC, 2020g) refers to the EGD as a blueprint for joint action aiming at a green transition, while the accompanying Staff Working Document (EC, 2020h) sets out a green agenda for the Western Balkans and proposes relevant actions, with several of them targeting agri-food.

6. **Following the need to comply with the EGD provisions and at the same time, contribute to the United Nations Sustainable Development Goals, the agri-food sector in Western Balkan countries should pursue a sustainable trajectory backed by a green transition.** The agri-food sector must unleash its untapped potential. The region has good opportunities to develop dynamic and more competitive agri-food systems, which are also environmentally sustainable and inclusive. There is considerable room to improve agricultural productivity by providing public goods (including advisory services and research and development), investing in technology and innovation, and incentivizing capital intensification. Repurposing public support is key to the improvement of agricultural productivity growth, but also for environmental performance and structural transformation. Investing in agricultural assets, in high-value agricultural products, and in an enabling environment, can significantly improve the sector's performance, while in parallel preserve the environment and natural resources and enhance income- and job-generating opportunities in rural areas.

7. **This report focuses on a case study of North Macedonia's agri-food sector and investigates its potential and necessary actions for adopting a green growth trajectory**. The agri-food sector is in need of transformation to achieve green growth in the country. This is not only because of the economic importance of the sector; it is also due to its vulnerability to climate change and other environmental risks which will compound current sector inefficiencies, including its declining competitiveness. In fact, the World Bank reports (World Bank, 2014; 2019a) that the potential of the sector could be untapped "…only if adequate policies and investments are implemented and if adaptation measures are taken…". Within this context, this report aims to assess: (i) actions needed to re-focus agricultural support priorities in a manner that reflects green growth ambitions; (ii) policy financing implications; and

[4] In fact, this is rather clearly indicated in the 2020 and 2021 European Commission Communications on EU Enlargement Policy (European Commission, 2020g; 2021).

(iii) the availability and capacity of effective policy implementation mechanisms. Finally, the potential impacts of greening agriculture support on farm efficiency are assessed and discussed.

8. **This report is developed along the following entry points.** First, there is a mapping and assessment of the "green" agriculture policy support mix and related recommendations for adjustments of current policies in North Macedonia. This includes a mapping of the F2F Strategy and other EGD strategies directly linked to agriculture and an assessment of the compatibility of the current policy mix in North Macedonia with those strategies. Relevant documentation on F2F and Biodiversity Strategies targets and detailed information on North Macedonia and the EU, specific to these targets, are presented and commented upon. This information is combined with an analysis of factors which are likely to affect North Macedonia's progress in the achievement of each EGD-agriculture target,[5] including agriculture and rural development policy, sectoral structures, enabling environment and implementation capacity,[6] and investment and funding capacities. Changes in agricultural policy are explored, and where relevant, policy-funding implications are assessed. Possible shortcomings are identified, and specific actions are recommended for the effective design and implementation of a "greener" agricultural policy mix. Second, the most recently available individual-farm FADN dataset is used to estimate the technical and scale efficiency (TE and SE) performance of farms in North Macedonia and assess the impacts of drivers associated with current production practices and the agriculture policy support mix. Subsequently, estimates are derived on farm performance differentials associated with the application of production methods of different levels of input intensity, allowing for the assessment of the potential impacts of greening agriculture support on farm efficiency. Finally, the report provides recommendations on improving the use of public resources in the sector to enable its transition to a sustainable future.

[5] Under the assumption that EGD targets are country specific.
[6] Based on the recently completed Functional Review (World Bank, 2019b), there is an assessment of the capacity of MAFWE and other relevant institutions to implement a greener policy mix for the sector.

MAPPING AND ASSESSMENT OF "GREEN" AGRICULTURE POLICY SUPPORT MIX IN NORTH MACEDONIA

EU Agricultural Policy and European Green Deal Targets

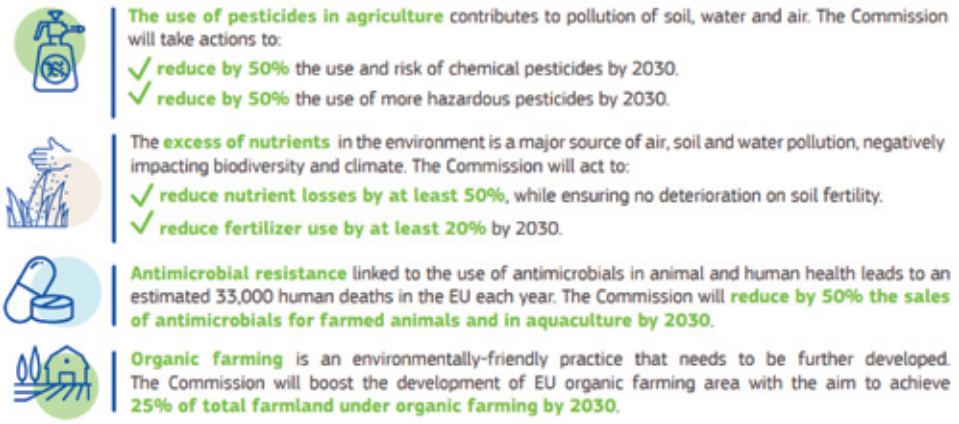
9. **Agriculture in Europe needs to produce food to meet consumer demand, while limiting adverse impacts on the environment and adapting to changing climate conditions.** In response to this challenge, the 2013 CAP reform introduced a green direct payment scheme to further improve the sustainable management of natural resources linked to farming, through payments for practices that are beneficial to the environment and the climate. In addition to crop diversification and the maintenance of permanent grassland, "greening" required farmers to reserve 5 percent of their arable land for ecological focus areas. The recently adopted CAP for 2023-2027 aims to make EU agricultural policy more responsive to climate change and environmental challenges, recognizing the role of farmers and agriculture in addressing climate change, protecting the environment, and preserving landscapes and biodiversity. In this regard, the new CAP gives EU Member States the support and tools to contribute to climate and environmental targets. These include enhanced conditionality; eco-schemes which are expected to unlock new funding and incentives for climate- and environment-friendly farming practices; agri-environment-climate measures and investments aiming to promote resource efficiency and facilitate the transition toward a low-carbon, climate-resilient economy; and a farm advisory system which will utilize economic and environmental data to deliver up-to-date technological and scientific information to advise farmers. Further, at least 40 percent of the new CAP budget should be climate-relevant.

10. **As in the case of every major EU policy, the new CAP must align with EGD ambitions.** As noted in the EGD Communication, CAP strategic plans should fully reflect the ambitions of the EGD and the F2F and Biodiversity Strategies. Further, the CAP strategic plans of EU Member States will be assessed against robust climate and environmental criteria.

11. **The F2F Strategy details the challenges of sustainable food production and supports a paradigm shift linking food production and consumption to environmental, health, and social benefits**. While it recognizes that EU food production systems are already a global standard on several fronts (e.g., animal and plant health), it argues that more could be done to make European food systems the global standard for sustainability. The F2F Strategy identifies key targets to address environmental sustainability (Figure 1), such as the reduced use of pesticides (-50 percent by 2030), reduced nutrient losses (-50 percent by 2030, which implies reduced fertilizer use of 20 percent), reduced sales of antimicrobials for farmed animals (-50 percent by 2030), and a commitment to dedicate 25 percent of agricultural land to organic farming by 2030. Further, it sets up a target of 100 percent access to fast broadband internet in rural areas by 2025. The F2F and Biodiversity Strategies are also expected to play an important role in meeting the 55 percent GHG emissions reduction target by 2030 (compared to 1990 values) and to climate neutrality by 2050 (EP, 2020). The F2F Strategy also aims to contribute to achieving a circular economy by acting on food transport, storage, packaging, and food waste.

Furthermore, it recognizes that this sustainable transition requires a shift not only on how farmers produce but also in food diets, to drive the demand for sustainable and nutritious foods. Finally, it argues that making European food "sustainable" can add a competitive advantage and open new business opportunities for European farmers.

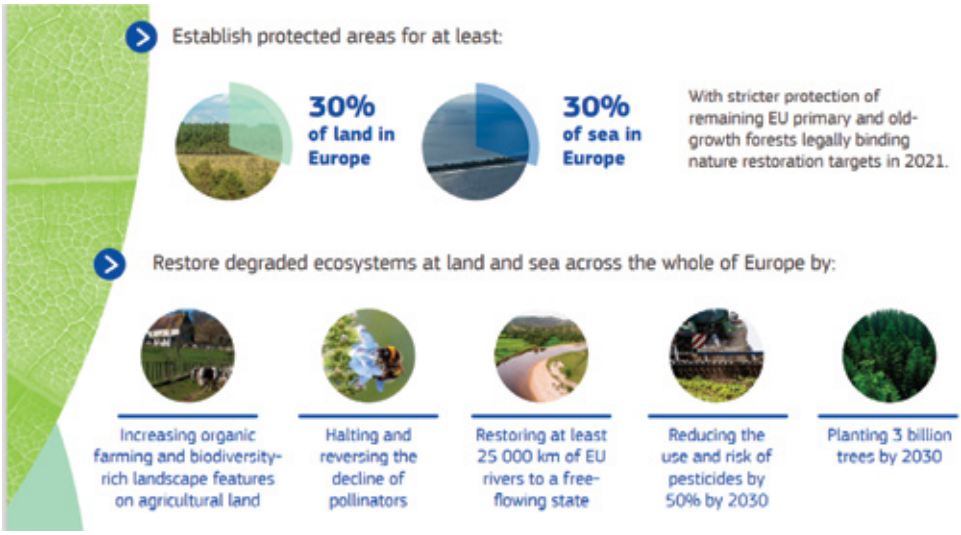
Figure 1. Farm to Fork Strategy Targets



Source: Farm to Fork Factsheet, EU Commission.

12. **The symbiotic relationship between agriculture and biodiversity is widely recognized.** Biodiversity provides essential services and functions for agriculture, while in parallel, sustainable agriculture promotes and enhances biodiversity. Agricultural intensification has led to a sharp homogenization of agricultural landscapes and loss of natural and semi-natural habitats and the biodiversity that depends on them. Currently, biodiversity is being lost at an alarming rate jeopardizing ecosystem services that agriculture depends upon. In the EU, it is estimated that only 23 percent of species and 16 percent of habitats under the EU Natura Directives are in good health. Accordingly, the Biodiversity Strategy argues that there is an urgent need to establish protected areas for at least 30 percent of land in Europe and bring back at least 10 percent of agricultural area under high-diversity landscape features, both by 2030 (Figure 2). Sustainable practices such as buffer strips, rotational or non-rotational fallow land, hedges, non-productive trees, terrace walls, and ponds are all interventions that can provide vital resources to support biodiversity and help enhance carbon sequestration, prevent soil erosion and depletion and support climate adaptation, while also contributing to agriculture production gains. The EGD Biodiversity Strategy recognizes that EU farmers and agricultural producers play a very important role in managing biodiversity. It highlights the importance of working with them to support and incentivize a transition of sustainable practices through agroecology, agroforestry, organic agriculture, and soil restoration, among other actions.

Figure 2. Objectives of the EU Biodiversity Strategy 2030



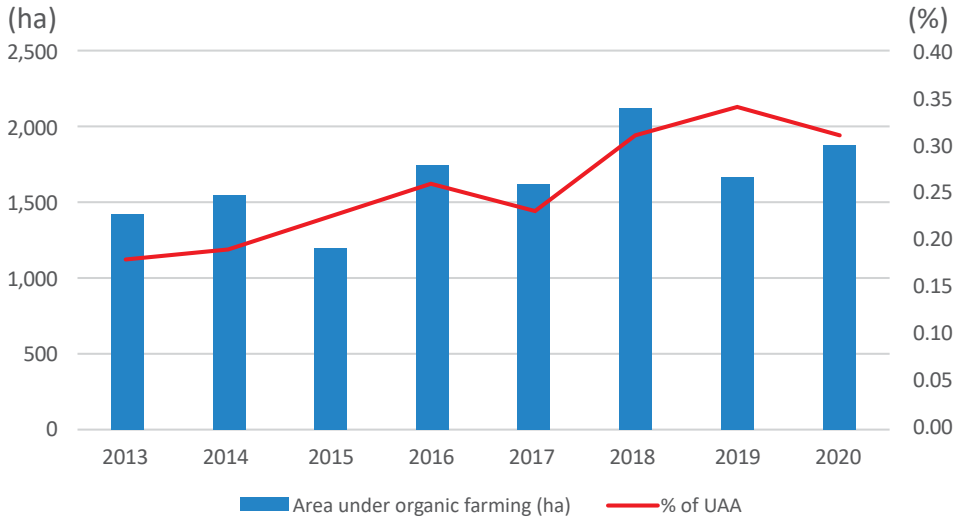
Source: Biodiversity Strategy Factsheet, EU document.

North Macedonia vis-à-vis the European Green Deal Targets for Agriculture

13. **Currently, North Macedonia lags behind the green growth ambitions reflected in the EGD, and F2F and Biodiversity Strategies.** In 2020, organic farming corresponded to 0.36 percent of farmland, vis-à-vis an EGD target of 25 percent for 2030, and since 2018, the area fully converted to organic farming has declined (Figure 3). The share of fallow land in total UAA[7] was 2.4 percent in 2016 (compared to 3 percent in 2013), against an EGD target of 10 percent. In 2018-2019, the annual average use of fertilizers fell by 16.3 percent compared to the 2012-2014 average levels, against an EGD target of at least a 20 percent reduction by 2030[8] (Figure 4). According to FAO, the annual use of pesticides has remained constant at 98 tons per annum from 2009 to 2019; this constant consumption is very far from the EGD target for a 50 percent reduction in the use of pesticides by 2030 (compared to the annual average 2015-2017 baseline). North Macedonia is lagging vis-à-vis the EGD target to establish protected areas for at least 30 percent of the land in Europe. Currently, 8.9 percent of the country's territory is covered by protected areas (Ministry of Environment and Physical Planning [MEPP], 2018). North Macedonia is progressing in terms of reducing GHG emissions from agriculture. According to FAO, total annual average GHG emissions in agriculture in 2017-2019 amounted to 1,417.19 kt of CO_2 eq. (AR5) and were 25.7 percent lower than in 1990. Finally, due to the lack of data for North Macedonia's use of veterinary antimicrobials, this target is not assessed here.

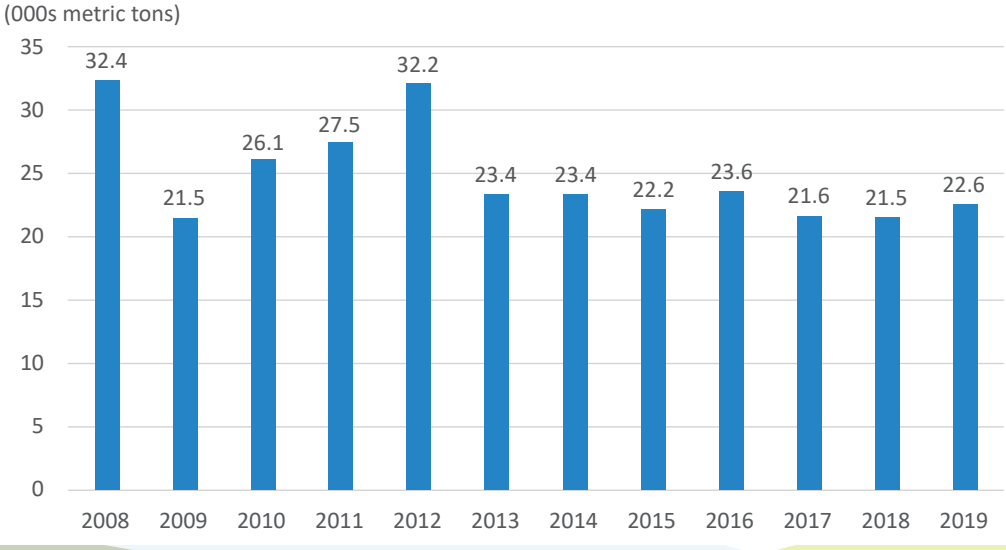
[7] Used by the Commission as a proxy for agricultural area under high-diversity landscape features (EC, 2020a).
[8] The target for a 50 percent reduction of nutrient losses is linked to a 20 percent reduction in the use of fertilizers (EC, 2020a).

Figure 3. Area under organic farming, North Macedonia, 2013 – 2020



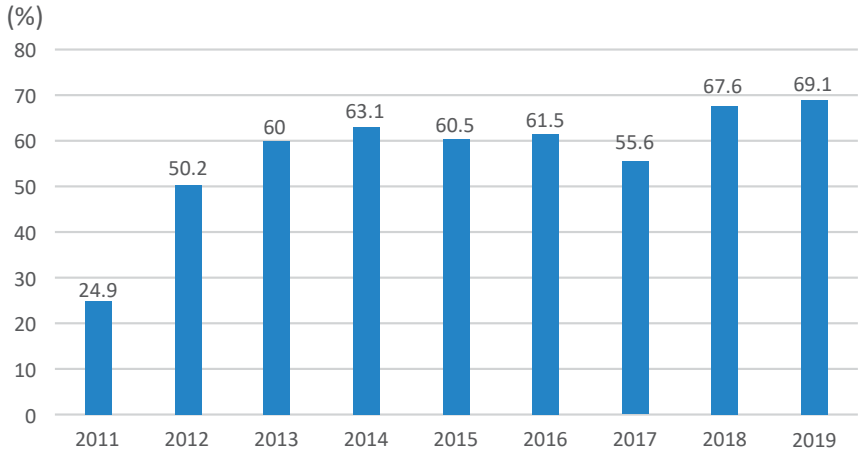
Source: MAKStat Database.

Figure 4. Consumption of fertilizers, North Macedonia, 2008 – 2019 (000s metric tons)



Source: IFASTAT.

Figure 5. Share of rural households with access to broadband internet North Macedonia, 2011 – 2019 (%)



Source: MAKStat Database.

14. **Despite lagging behind some EGD targets, North Macedonia is doing better than the EU-27 for others.** These include fertilizer use, pesticides use,[9] broadband coverage in rural areas, and GHG emissions. Even in the case of EGD targets for which North Macedonia outperforms the EU-27, it seems that a considerable distance exists between the status quo and EGD target values, except for broadband coverage.

Table 1. Status quo vis-à-vis quantified European Green Deal targets for agriculture, North Macedonia and the EU

EGD ambitions	North Macedonia	EU-27	EGD targets
Organic farming (% of farmland under organic farming)	0.36% (2020)	8% (2018)	25% by 2030
High-diversity landscape (% share of fallow land in UAA)	2.4% (2016)	4.6% (2018)	10% by 2030
Use of fertilizers (% change between the 2018-2019 average and the 2012-2014 average)	-16.3%	+3.8%	-20% by 2030
Use of pesticides (% change between the 2018-2019 average and the 2015-2017 average)	0	+6.6%	-50% by 2030
Fast broadband coverage in rural areas (% share of rural households with Next Generation Access Broadband)	69.1% (2019)	56.4% (2019)	100% by 2030
Protected areas (% of land)	8.9% (2020)	26% (2020)	30% by 2030
GHG emissions from agriculture (% change between the 2017-2019 average and 1990)	-25.7%	-20.1%	-55% by 2030

Source: World Bank staff calculations from FAOSTAT, IFASTAT and Eurostat.

[9] The European Commission (2020a) uses the Harmonized Risk Indicator 1 (HRI1) to assess EU performance on this target, and in fact, it records a declining trend of -17 percent (between 2011-2013 and 2018); HRI1 is not available for North Macedonia and instead FAOSTAT data on fertilizer consumption is used here.

Factors Affecting the Attainment of European Green Deal Targets for Agriculture in North Macedonia

Context

15. **The agri-food sector is an important part of North Macedonia's economy.** In 2020, the primary agriculture sector accounted for around 9 percent of gross domestic product (GDP), 14 percent of employment, and around 10 percent of total exports. Between 2011 and 2020 its contribution to overall economic growth has been declining, however at a rather slow rate, due to the higher value added in other economic activities. During the same period, agricultural GDP has fluctuated more than total GDP. The agri-business sector is also an important industry for the country's economy, in terms of both employment (19 percent of total manufacturing jobs) and turnover (22.8 percent of total manufacturing turnover) (World Bank 2019c). North Macedonia exports fruits and vegetables, tobacco, beverages (mostly wine), and sheep meat. The primary agriculture balance of trade has been improving since 2014. In total, the share of the agri-food sector (including food processing) in the national GDP is around 12 percent (MAFWE, 2020).

16. **Crop production dominates agricultural production and accounted for 77 percent of total value in 2019; the remaining 23 percent came from livestock production.** Wheat and vegetables are the main contributors. Potatoes, tomatoes, and peppers dominate vegetable production and make North Macedonia a net exporter of processed vegetables. Other important agricultural products are fruits, cereals, tobacco, and grapes for wine production as well as direct consumption. Livestock output is less important, with dairy farming and cow milk production dominating this sub-sector.

17. **Although the country's food safety standards have improved, its food safety and veterinary policies, as well as relevant infrastructure, are not yet aligned with the standards of the EU Acquis**. Aligning food safety standards with EU requirements is essential for the successful growth of the food processing industry and the free movement of agricultural produce, especially in export markets. As North Macedonia moves towards EU accession, MAFWE's key objectives to address these food safety challenges include: (i) upgrading its food safety standards for products of animal origin, including the establishment of safe disposal of animal by-products (ABPs) system; and (ii) setting up of an EU-compliant system for the official control of live animals and animal products (EC, 2021a).

18. **Despite its productive potential, agriculture in North Macedonia faces structural problems that hinder its development.** These include unfavorable farming structures (small and fragmented land holdings), unresolved land property rights, low efficiency and productivity, limited use of technology, high labor intensity, low financial liquidity, limited capital and credit availability for investment (especially for smallholders), outdated production and post-harvest management and practices, limited and technically outdated storage capacities, and lack of sufficiently large and reliable volumes of agricultural quality products (World Bank, 2019c).

19. **Farm structures impede technological investment, and together with climate factors, negatively affect agricultural productivity.** Agricultural holdings are small and fragmented, with 58 percent of farms operating on less than 1 ha, and 95 percent on less than 5 ha. These shares are higher than in other Western Balkan countries. Furthermore, 55 percent of farms have a standard output of less than EUR 2,000 per production year, which confirms the significance of subsistence and part-time farming (World Bank, 2019c). Structural problems such as lack of irrigation, poor public infrastructure, weak advisory services, low access to credit and poorly functioning land markets currently constrain the competitiveness of North Macedonia's agri-food sector. Limited access to credit has been one of the main problems hindering the development and modernization of agriculture holdings (Government of North Macedonia, 2021). This is due to the low interest of financial institutions to finance agriculture and rural activities, but also because farmers and rural entrepreneurs generally have low education levels, limited knowledge of commercial credit, and they prefer informal borrowing. Subsequently, net fixed capital formation in agriculture has been negative in recent years, which means that investment activity in the sector is insufficient to promote its modernization (Government of North Macedonia, 2021).

20. **Labor productivity on-farm is low, and underemployment is high.** Small size and low farm capital utilization have led to persistently low labor productivity and underemployment, even though around 40 percent of farm managers are under 40 years old. Structural constraints faced by North Macedonia's agriculture sector impede these younger farmers from realizing their potential, while their comparatively low level of education constitutes a further constraint to technology adoption.

21. **Diversifying employment off-farm is difficult.** Low labor productivity, on-farm, coupled with a comparatively young farm labor force would normally drive a shift towards off-farm employment. However, in North Macedonia, only 15 percent of farmers have other gainful activities. Lack of alternative employment opportunities, and credit availability constraints, hinder the transfer of resources from agriculture to other gainful rural sectors.

22. **The agriculture sector in North Macedonia is currently not doing enough in the context of green growth.** Agricultural systems in the country are poorly adapted to the current climate, and sectoral inefficiencies will be exacerbated by climate change in the future (World Bank, 2014).[10] In fact, many priority measures promoting adaptation can also benefit sector efficiency (Sutton et al., 2013). Problems include limited water availability, with inadequate irrigation hindering productivity, and climate change is expected to exacerbate this problem. Water pollution risks are high in intensive agricultural regions with mono-cropping patterns near water sheds and lakes. Soil fertility problems include erosion,[11] soil-born pests and diseases, soil pollution caused by unsustainable use of agrochemicals (fertilizers and pesticides) and inappropriate use of irrigation water,[12] and a rapid decline of soil organic matter

[10] In fact, climate projections forecast a rise in temperatures, in the variability of precipitation, and in the intensity of rainfall (World Bank, 2014; Ministry of Environment and Physical Planning, 2021).
[11] According to FAO, 52 percent of the country is subject to soil erosion
[12] As a result of inefficient irrigation schemes and on-farm irrigation equipment.

and salinization, all affecting farm productivity. Soil erosion causes yield reduction and produces sediment, which pollutes waterways. This situation is expected to worsen with climate change. Biodiversity also faces degradation problems due to land abandonment and traditional cattle breeding in hilly and mountainous areas that lead to the deterioration of semi-natural habitats and traditional landscapes. The small parcel size is a serious obstacle to the implementation of agri-environment or adaptation measures. Another problem is the marginalization of agricultural activity, which further triggers agricultural land abandonment. Further, primary producers possess low adaptation capacity due to financial and know-how limitations (RRD-SWG-SEE, 2018). These problems persist despite subsequent NARDS strategies (MAFWE, 2014; 2020) that aim to tackle these problems and promote a sustainable agriculture model that protects the environment and biodiversity.

23. **Human capital development, knowledge transfer, and advisory services in the country need to be transformed to contribute to the improvement of the sector's economic and environmental performance.** North Macedonia's Agriculture Knowledge and Information System (AKIS) has not managed to help overcome the sector's structural constraints. In fact, no formal integrated system has yet been established and AKIS actors lack strategic guidance. The upgrade of the AKIS has been introduced as a target of the 2021-2027 NARDS (MAFWE, 2020), where it is foreseen that a national integrated AKIS established according to European standards will be regulated by a special Law on Systems of Knowledge and Innovation in Agriculture. This law will cover the components, planning, implementation, and financing of the system, organized through a separate program for knowledge and innovation in agriculture. The country's public advisory system is implemented by the National Extension Agency (NEA) established in 2001. The NEA advisory capacity is narrow in terms of advisory services provided to farmers and on advisory methods applied. NEA activities are mostly characterized as extension, acting as information points for farmers regarding national support policies (Government of North Macedonia, 2021). NEA advisors have insufficient capacity to prepare farmers on emerging technologies and production standards compatible with EU accession requirements. Capacity on agri-environment aspects and skills related to economic analysis and farm business management are very limited. Links of NEA advisors with research is rather limited and this does not facilitate the provision of advice on innovation. The private sector is emerging in extension and advisory services but is still in its initial phase of development. Public and private advisory services remain very weak or absent in providing quality support to potential recipients. Also, the absence of information and communication is identified as another gap. Recognizing these weaknesses, MAFWE has prepared a draft Law on Establishment of an Advisory System for Agriculture and Rural Development, which is planned to be submitted to Parliament in 2022.

24. **The level of public support for agriculture in North Macedonia has been generous and in recent years there seems to be more emphasis on rural diversification and environment-natural resources.** Between 2017 and 2020, budgetary transfers to farmers represented 1.19 percent of GDP (around MKD 7.8 billion per year) and were, on average, double that of other Western Balkans (WB6)

countries[13] and almost 60 percent higher than the EU average. Direct farm subsidies, which are coupled to production, amounted to 1.10 percent of GDP in 2017-2020, which is more than three times the EU average. Over the 2017-2020 period, market support and direct payments represented 81.3 percent of agriculture budget outlays, which is an increase of 1.3 percentage points over the 2010-2016 period. Around 62 percent of this support benefitted the crop sector and largely favored low-value farm production. Indicatively, tobacco, which made up around 6 percent of agricultural output value in 2017-2020, accounted for 25 percent of direct support by product in the same period, and field crops (7.3 percent of agriculture output value) for 10.2 percent. Rural development accounted for 10.6 percent of total support. In contrast to the first half of the 2010s, when it was dominated by support on farm competitiveness, support currently focuses on rural diversification (44 percent of rural development expenditure), while both farm competitiveness (31 percent) and environment and natural resources (25 percent) command significant shares of the rural development envelope. Food safety and veterinary services account for 7.2 percent, while expenditure for extension services was quite low (0.9 percent).

25. **Agricultural support structures are slowly evolving, while the structure of public spending on agriculture has raised questions about its overall effectiveness and capacity to facilitate structural adjustment.** Direct payments schemes are complex (EC, 2020g), and remain coupled to production[14] with limited application of cross compliance rules, while the country also applies input subsidies, and payments for mountain areas, young farmers, and organic production. Eligibility payment thresholds are applied based on size. Certain types of direct payments have been present since the late 2000s, while others change annually. Subsidy intensity is quite high; on average, direct payments represent 34.3 percent of farm net value added (FNVA) (MAFWE, 2020), which is quite high compared to the EU average of 27.2 percent (World Bank, 2021). Subsidy intensity increases with farm economic size, ranging from 27 percent for very small farms to 56 percent for farms with a standard output over EUR 50,000. Also, it varies depending on agricultural sub-sectors: the FNVA is 42-70 percent for milk, sheep, and goat producers, 5 percent for horticultural crops, 26 percent for viniculture, and 14 percent for perennial crops.

26. **Rural development support has been better aligned to the CAP and has three priority axes, which correspond to the 2007-2013 CAP.[15]** Rural development has been further supported by the Instrument for Pre-accession Assistance for Rural Development (IPARD) I and II, with good progress being recorded in implementation. Rural development expenditures, however, only represented a small share of total agricultural public expenditure in the country (World Bank, 2019b).

27. **Support on general measures is primarily destined to veterinary services and food safety, followed by knowledge transfer and extension services.** Public advisory services lack sufficient capacity and resources, while in the case of food safety, further progress is necessary on aligning national legislation with the EU

[13] WB6 countries: Albania, Bosnia and Herzegovina, Kosovo, North Macedonia, Montenegro, and Serbia.
[14] However, the 2021-2027 NARDS promises a decoupling of direct payments support.
[15] Namely, increase sector competitiveness, achieve sustainable resource management, and improve living conditions in rural areas.

Acquis, and strengthening capacity on data analysis (EC, 2021a). In general, institutions associated with agriculture and rural development are weak, capacity needs to be improved and a reorganization towards a structure which reflects current and future sector needs and policy priorities is necessary (World Bank, 2019b).

28. **Considerable efforts are needed to improve policy domains which are relevant to the environment, natural resources, and climate change.** Relevant institutions lack human resources, coordination and inter-sectoral cooperation are limited, and financial resources are insufficient to effectively implement these policies. Some progress has been made to align with EU phytosanitary standards; however, more efforts are necessary to implement legislation on plant protection controls and the sustainable use of pesticides. Laws on waste management have not been adopted and economic incentives to promote more circular practices remain limited; administrative capacity, law enforcement and inter-sectoral cooperation are insufficient. Also, the country needs to make significant efforts to implement the EU Acquis on water quality (EC, 2020g), including the development of monitoring systems and the completion/implementation of river basin management plans. On nature protection, valorization studies and management plans have been developed and potential NATURA 2000 sites have been identified, but progress on the designation/proclamation of new protected areas and their effective management has been very slow. Finally, a climate law is close to adoption, and a strategy on climate action has been recently adopted (EC, 2021a; MEPP, 2021).

29. **Strategic choices for agricultural and rural development policy in 2021-2027 are aligned with the new CAP and, in principle, respond to the sector's challenges.** The 2021-2027 NARDS (MAFWE, 2020) serves as the major long-term strategic document that defines objectives, policies, and measures for agriculture and rural areas in the country. The Strategy's key policy goal fully adopts the 2023-2027 CAP framework in both its strategic objectives and ten specific objectives. The 2021-2027 NARDS includes a commitment for a gradual adoption of decoupled support, including schemes foreseen in the 2023-2027 CAP (additional support for income redistribution for sustainability, additional income support for young farmers, special support for small farmers, climate and environmental support interventions, eco-schemes). Perhaps more important, the 2021-2027 NARDS foresees a flat rate of Basic Income Support for Sustainability (BISS) through the provision of a single amount per hectare of cultivated agricultural land in the amount of MKD 12,000, regardless of the type of cultivated crop. To provide the full amount of support, beneficiaries must meet all the cross-compliance requirements and use certified seed material. Support will be additionally conditioned by the mandatory application of basic agro-technical operations and the vitality of a minimum number of perennial plantations. Starting in 2022, support will be provided for all eligible arable land, including land used for tobacco production. Other crop areas will join payments of this type not later than 2024. The 2021-2027 NARDS also foresees an extensive program of coupled support that targets several agricultural sub-sectors including cereals, which are crucial for food safety; tobacco; meat and milk; wine grapes; fruits and vegetables; seeds and planting material; and medicinal, aromatic, and spice plants. Further, following the provisions of the new CAP, sectoral programs will be implemented for fruits and vegetables, wine (and wine grapes), beekeeping, meat, milk, and eggs.

30. **The rural development interventions of the 2021-2027 NARDS also follow the logic foreseen in the CAP Strategic Plans Regulation.**[16] Interventions on environmental protection and conservation, conservation of natural resources, and adaptation and mitigation of the effects of climate change are prioritized and (among others) introduce a risk management instrument and interventions on knowledge and information transfer. Also, several actions are planned on natural resource management and mitigation of the impact of climate change, with an emphasis on water management, land management (including land consolidation), and "combating" the main sources of GHG emissions in agriculture (e.g., enteric fermentation).

31. **NARDS also foresees horizontal actions, which aim to address constraints in the agri-food sector**. Actions are underway to update and supplement cross-compliance, namely "Good Agricultural and Environmental Conditions" (GAEC) and "Statutory Management Requirements" (SMR), including improving the institutional capacity of the NEA, and facilitating implementation, controls, and support to farmers. To improve the economic and sustainability performance of farms and agri-businesses, advisory services are planned to be provided to farm support beneficiaries through a formal system, aiming to enable the transfer of information on new technology and innovation. Also, the strategy includes plans to support the digital transition of agriculture and to strengthen links between AKIS, digitization, and advisory services, while mandatory training and education is foreseen to improve capacity in agriculture. Several measures also aim to improve the food safety and veterinary health systems, and to promote sustainable practices on plant protection and fertilizer use. Also, specific actions aim to improve institutional capacity and ICT systems for strategy implementation, upgrade MAFWE staff competencies, and develop a modern Agriculture Information System for policy monitoring and evaluation.

32. **NARDS foresees a significant restructuring of public support to agriculture and rural development.** According to its financial plan, the direct payments envelope will slightly decrease (by around 6 percent) compared to its 2017-2020 annual average levels. However, average annual spending on rural development is projected to record a fourfold increase compared to the 2017-2020 annual average. Complementarity between investments supported by the National Program for Financial Support of Rural Development and the IPARD Program is pursued through the clear demarcation of the eligible costs of the proposed investment, as well as the minimum investment threshold.

Organic Farming

33. **Organic farming contributes to the improvement of all relevant issues associated with the environmental impacts of agriculture.** These include pollution, loss of biodiversity, water quality, and soil fertility. It also reduces the sector's emissions of greenhouse gases and ammonia, which contribute to climate change mitigation and the improvement of air quality.

[16] Regulation (EU) 2021/2115.

34. **Organic farming in North Macedonia has been evolving slowly.** North Macedonia has the potential to develop organic farming because of its agro-climatic conditions and autochthonous varieties of traditional crops (El Bilali et al., 2014). However, in 2019, only 847 farm holdings (0.48 percent of all farms in the country) were certified as organic, or in transition (MAFWE, 2020). Although farmers have shown an increasing interest in organic production, the number of certified organic agriculture holdings, including processors and traders has only doubled since 2014. In 2020, only 1,881 ha of land were fully converted to organic (0.36 percent of farmland), compared to 2,123 ha in 2018. Around 1,372 ha were in transition to organic in 2020, compared to 1,846 ha in 2018. Organic crop production is currently dominated by fodder (34 percent of organic crop area), followed by cereals (23 percent), orchards (17 percent), aromatic and medicinal plants (12 percent), horticulture (10 percent), and oilseeds and vines (with 1-3 percent each). There has been an increased interest in raising organic cattle—in the 2014-2021 period, the number of heads more than tripled (from 2,726 to 9,752). In the same period, the number of sheep in organic production has doubled from 52,000 to 110,876 (from 7 percent to 16 percent of the total number of sheep in the country). Organic goat breeding also increased between 2014 and 2021 and the share of organic goats increased from 3.2 percent to 6 percent. An increase has been also recorded in organic beehives, which rose from 6,285 in 2014 to 11,055 in 2021. Organic production is mainly exported, as domestic demand is still rather limited. There is growing export demand for organic products, such as soil plants, herbs, spices, fruits, vegetables, and honey. The supply of processed organic products is relatively small and organic farmers and processors have limited linkages (RRD-SWG-SEE, 2018).

35. **The legislation, competent authority, control bodies, and accreditation and certification system for organic farming are established and operational in the country.** The 2009 Law on Organic Agricultural Production regulates the overall processes for production, processing, storage, transport, sale, labelling and control of organic products and is fully compliant with EU Acquis (EC, 2021a). There are two certification bodies (Balkan Biosert and Pro-Cert) authorized by MAFWE on control and certification in organic production, while the Institute of Accreditation of the Republic of North Macedonia (IARNM) inspects certification bodies. However, monitoring and control of organic certification and products need to be carried out more systematically (EC, 2021a).

36. **Public aid to organic farming is provided through support that compensates for the additional costs and foregone income resulting from the shift to organic farming.** Support for the development of organic farming in 2014-2020 was set at 30 percent of direct payments granted. For 2021-2027 it has been increased to 50 percent for crops, livestock, and beekeeping; 70 percent for fruit and viticulture; and 100 percent for horticultural production. The fact that average support rates for organic farming in the EU accounted for nearly 84 percent of direct payments (EC, 2019b; 2021b) indicates that under-compensation for conversion to organic could be one of the reasons for the slow uptake of organic farming in North Macedonia.

37. **National Plans for Organic Production have not reached their targets.** The first plan for 2008-2011 did not achieve its target to increase the organic crop area to 2 percent of UAA. The second National Plan for Organic Production, for the 2013–2020 period (MAFWE, 2013a), set a target of 4 percent of UAA under organic production and 4 percent of total livestock as organic. Both plans did not reach their targets with regard to crop production and in 2021, only 0.58 percent of UAA was fully organic or under conversion. However, organic livestock production has been performing quite well vis-à-vis specified targets. In 2021, 13 percent of total cattle, sheep, goats, and beehives were organic.

38. **Structural constraints characterizing agriculture in North Macedonia seem to contribute to the poor uptake of organic farming.** Farming in the country is practiced predominantly by small-scale, subsistence and semi-subsistence farms. These generally poorly educated farmers have limited entrepreneurial skills, financial capacity, and technical know-how. Liquidity for investments and innovation uptake are low. Public extension services have so far not been able to effectively promote organic farming. Structural constraints highlighted earlier, combined with insufficient educational and informational activities for organic farmers hinder the development of organic production. Farmers receive support (subsidies) to introduce organic production but not many apply for such subsidies (RRD-SWG-SEE, 2018). Very few farmers have agricultural education or knowledge in nature conservation and have difficulties meeting organic farming requirements (Stefanova et al., 2012). There are problems with the low supply of input materials for plant production in the domestic market, including seeds and seedlings and protection products that can be applied to organic plant production. The limited availability of animal feed and appropriate veterinary medicine for organic livestock breeding will need to be improved in order to develop certified organic meat and milk products. Food processors involved in the organic market have low capacity, financial access, and marketing skills and the integration of the organic food chain is rather poor (Government of North Macedonia, 2021). The organic food chain is further hampered by the insufficient supply of primary organic products (RRD-SWG-SEE, 2018).

39. **Low support amounts may have contributed to the limited expansion of organic farming.** Agri-environment payments compensate for the additional costs and/or foregone income associated with the conversion to organic farming. But such payments do not fully account for negative agricultural externalities and do not reward farmers for positive externalities by providing them an additional incentive–an extra, above the costs occurred and/or income foregone (Stefanova et al, 2012). In addition, due to the lack of accreditation, an organic farming measure was not applied in IPARD II.

40. **Limited public awareness of the benefits of organic products is another obstacle.** Because of insufficient promotion, consumers have limited awareness of the advantages that organic production provides to the environment and human health. There are low quantities of officially certified fresh and processed organic plant products. Often, organic products are marketed without differentiation from conventional products. Low incomes and high trade margins imposed by the retail network make organic products accessible only to high-income households (RRD-SWG-SEE, 2018).

41. **Institutional capacity is underdeveloped to support organic production.** Advisors are not trained on the specificities of organic farming, while there are very few staff in MAFWE dealing with organic agriculture (World Bank, 2019b). The recently completed MAFWE functional review (World Bank 2019b) proposed the establishment of a new Unit for Organic Production (within the Food and Drinks Department), which will define the tasks related to the certification process (land conversion, production) and inspection, and manage the register of organic producers. The Unit will also deal with domestic and foreign market analysis to market organic production, and program national production and marketing support measures. The Unit will support the creation of national and Acquis-related laws for its field of competence in collaboration with the Legal Affairs Department. The implementation of organic farming support will be under the purview of the Rural Development Department. Also, the NEA will streamline its operations according to policy priorities, including those on the development of organic farming.

42. **Policy initiatives should focus on the removal of barriers and the creation of an enabling environment for the development of organic farming.** Building farmers' capacities by providing them with technical and administrative assistance can increase farmers' participation in organic agriculture. The feasibility of establishing various forms and institutional settings for collective agri-environment schemes can also be explored. Strengthening social and human capital to ensure a smooth and large-scale uptake of agri-environment measures requires understanding and cooperation between relevant stakeholders, a constant exchange of information, and capacity building. Policy coordination on organic farming, advisory services, and improvement of skills and competences would improve the professional expertise and knowledge of organic farmers, while synchronization with farm investment support and AKIS would facilitate the sector's modernization.

43. **Policy measures should also target organic processing and facilitate integration within the organic food chain**. In fact, the 2021-2027 NARDS increases the amount of support for the processing and trade of organic products. Support for food processing and marketing conditions should coordinate with organic farming support and contribute to the improved quality and food safety of organic primary products. Farm diversification support should also aim to link organic production with tourism. The promotion, advertising, marketing, and implementation of information campaigns and assistance for the better integration of organic producers in foreign markets and the development of trade channels should also be priorities for agricultural policy. Importantly, an improvement in the performance of pesticide controls for both conventional and organic products would also strengthen the confidence of consumers on the latter.

44. **All available policy resources should be utilized**. In this context, the accreditation of the measure for organic production supported by the IPARD III program is very important. Last, but not least, resources for organic farming should be increased and the current national targets streamlined with EGD goals. Annual average expenditure on organic farming support in 2017-2020 amounted to MKD 101 million (about USD 1.7 million). This was only 1.5 percent of direct payments during the same period. Assuming a 15 percent target for the country's UAA under organic farming and an

average rate of support close to 70 percent of direct payments leads to an estimate of MKD 730 million (about USD 13 million) per annum for organic farming support. This amount corresponds to 15 percent of the rural development envelope for 2021-2027 (MAFWE, 2020). Given the necessary upgrade of institutional capacity specific to organic farming, this financial target is assessed as realistic.

High-Diversity Landscape

45. **The high diversity of agricultural landscapes in the country is considered a strength for agriculture and rural development.** The country has 11 landscape types, which occupy 20 percent of its total area (Melovski et al., 2019). The main feature of North Macedonia agricultural landscapes is intensively cultivated agricultural land (unlike rural landscapes where heterogeneous extensive agriculture is predominant). The composition of this landscape group is determined by the dominant participation of the land cover typically representative for agricultural landscapes; non-irrigated arable land, complex cultivation patterns, and land principally occupied by agriculture, with significant areas of natural vegetation. The main types include large areas of fields and croplands with cereal crops, as well as large areas of vineyards, planted on heterogeneous and smaller croplands and fields (MEPP, 2018a). Agricultural systems with high diversity and nature value include combined systems of extensive pasturing on semi-natural grasslands and semi-intensive agriculture, semi-natural meadows or planted meadows used for hay, winter pastures, summer pasturing on highland pastures, old extensive or semi-intensive orchards, and systems of mosaic formations (Stefanova et al., 2012).

46. **Rural landscapes are high in diversity**. They account for 25 percent of the country's total area and include hilly, rolling, and mountain rural landscapes with the latter characterized by the highest diversity. The main feature of rural landscapes are extensive land management practices reflected by small-scale heterogeneous agriculture (fields and meadows). Livestock breeding also has an important role in rural landscapes. The rural character of the landscape is determined by different land cover classes, including land principally occupied by agriculture, with significant areas of natural vegetation and mixed cultivation patterns (MEPP, 2018a). Further, climatic conditions, landscape, and the extensive character of agricultural practices in mountain regions suggest that most of the traditional farming systems classified as mountain landscapes can be regarded as 'high-diversity'.

47. **The dominant characteristic of high-diversity landscapes in North Macedonia is low intensity land use.** Historically, the dominance of small-scale farms in the lowlands and semi-natural grassland in the uplands and mountains led to the creation of a diverse agricultural landscape in the country. Semi-natural vegetation is also significant, often in combination with low intensity cropped areas, creating a mosaic landscape with a greater diversity of land cover. In mixed semi-natural vegetations and low-intensity croplands, the proportion of cultivated land is greater, and the management of cultivated land and the existence of ecological landscape features is critical for wildlife. More intensive use of cultivated land and the removal of features would lead to a rapid decline. In fact, production expansion and intensification after World War II affected agricultural landscapes. The traditional agricultural landscape of

the lowlands has been lost to intensive agriculture and almost all major swamps and marshes were drained to create new agricultural land (Republic of North Macedonia, 2021).

48. **Threats to agricultural landscapes are complex and brought up by local, regional, and national socio-economic development factors.** The main risks include the abandonment of traditional livestock breeding practices and traditional agricultural practices. The first increases the area of heaths and scrubs and leads to forest overgrowth, affecting the structural and functional properties of hill and mountain grassland landscapes. The abandonment of traditional agricultural practices leads to scrub encroachment, loss of hedge structures and loss of areas under fields and meadows, ultimately leading to the loss of species diversity. The intensification of agricultural practices leads to the loss of small-scale agriculture and of hedges, thus affecting corridor arrangement and limiting corridor functionality in agricultural landscapes. The intensification of agricultural practices also leads to more uniform structures and thus affects the visual quality of agricultural landscapes (MEPP, 2018a; 2018b).

49. **In recent years, the biggest threat to the diversity of agricultural landscapes in North Macedonia has been the large number of pastures (in uplands and mountains) and meadows (in lowlands) that are lost to land abandonment and the cessation of traditional farming practices**. Due to the abandonment of traditional land use practices caused by rural-urban migration, a large portion of rural landscapes is affected by the ongoing natural succession especially notable in meadows and grasslands, while many villages are being transformed into tourist settlements or abandoned. This transformation contributes to the loss of landscape specifics and leads to a decline in rural landscape diversity. According to the Biodiversity Strategy and Action Plan, "The diversity and mosaic-like distribution of habitats characteristic of traditional agriculture are seriously threatened. As a result, it is expected that, in two or three decades, this portion of the landscape will disappear, having been modified into shrubs and low forests" (MEPP, 2018b).

50. **An ageing rural population with low incomes and poor infrastructure are all factors contributing to this trend.** In marginal and remote areas (including hilly and mountain grasslands), land abandonment has led to the deterioration and disappearance of semi-natural grassland habitats and traditional landscapes. The traditional management of grasslands as well as low input, high crop diversity mixed farming, which maintained high nature value habitats, have ceased in many marginal but environmentally valuable areas. Also, significant neglect of traditional cattle-breading practices led to the gradual abandonment of areas used as pasture and subsequently, to the loss of the basic structural features of dry grasslands, which are open pastures. Public policy support aims to facilitate the viability of these communities and enable farmers to continue their activities. However, policy efforts have not succeeded in halting land abandonment.

51. **These challenges require an integrated set of measures that work together to benefit both the environment and the rural population**. Additionally, the successful implementation of such measures requires a genuine willingness to make

them work as well as experience to ensure they are implemented effectively, involving national and local administration, extension services, and farmers themselves.

52. **The government has attempted to initiate support for agricultural landscape diversity in North Macedonia, but with limited success so far**. Landscape diversity protection is pursued through various measures and activities for the conservation and maintenance of the characteristic values of the landscape resulting from its natural configuration and/or type of human activity. Many institutions and organizations are involved in biodiversity conservation and nature protection. MEPP develops and implements national policies on nature protection, including the protection of biological and landscape diversity, as well as enforces the provisions of the 2004 Law on Nature Protection. MAFWE covers the development and implementation of other important policies for biodiversity conservation, concerning, for example, agricultural land management, rural development, protection, and use of forests, etc. Various other institutions and organizations are involved in biodiversity conservation and nature protection.[17]

53. **Policy initiatives to support agricultural landscape diversity lack coordination.** The Department for Nature (part of the Administration for the Environment, MEPP) develops policies, provides technical expertise for the development of legislation, and oversees the implementation of policies and legislation in the fields of biodiversity and landscape diversity. The Law on Nature Protection is the main law in this regard. It prescribes landscape diversity protection in and outside protected areas. The Law also aims to protect landscape diversity, the valuation of landscapes, and the monitoring of their state. MAFWE funds measures such as agri-environment and climate, areas facing natural or other specific constraints (ANC), farm diversification, and investments in rural public infrastructure. Institutional capacity in both Ministries needs to be improved and coordination is lacking (UNECE, 2019; United Nations, 2020). The Department for Nature has only 13 employees responsible for all issues linked to nature protection. Agriculture landscape diversity is not among the jurisdictions of MAFWE units. Policy initiatives do not promote integration, and the monitoring of policy impacts on agricultural landscape diversity is non-existent (UNECE, 2019).

54. **The relevant policy framework may be strengthened if proposed measures are implemented in an integrated and effective manner.** In 2018, the National Strategy for Nature Protection for 2017-2027 and the National Biodiversity Strategy and Action Plan (NBSAP) for 2018-2023 were adopted. Landscape diversity is one of the objectives of the National Strategy for Nature Protection and the relevant Action Plan details five actions concerning landscape diversity and indicates the responsible body and timeline for implementation of each. For instance, the development of management plans for the most important types of landscapes is planned to be completed by 2027 (UNECE, 2019). Agricultural landscape diversity is included in National Targets 2 and 3 of the NBSAP. MAFWE is the leading responsible institution in actions covering both National Targets; other institutions involved include the MEPP (Target 3) and institutions such as the Rural Development Network, Federation of Farmers, Ministry

[17] Please see paragraph 54.

of Transport and Communications, the Agency for Real Estate Cadastre, and the Agency for Spatial Planning. There is no information on how these entities will be coordinated. The Law on Agriculture and Rural Development envisages support for improving the environment and the rural landscape (agri-environment measures) and the Rural Development Program (RDP) aims to promote agricultural production practices for the sustainable use of agricultural land, and the protection and improvement of the environment and rural landscapes (agri-environment measures). However, RDP spending in this arena in 2017-2020 was only 0.6 percent of total RDP outlays and it is very doubtful if any of this expenditure was related to agricultural landscape protection. The 2021-2027 NARDS foresees that by the end of the programming period, there will be a systematic analysis of agricultural landscape features and the protection of agricultural landscape diversity will be included in national agricultural policies. At the same time, the strategy falls short of committing any resources specifically for this topic and does not link agricultural landscape protection to wider rural development policies such as farm modernization and competitiveness and rural diversification and quality of life (including LEADER[18]).

Use of Fertilizers and Pesticides

55. When fertilizers and pesticides are not efficiently applied, reducing usage does not necessarily affect yields and production levels. Such a reduction can be achieved without a change in farming systems. However, it could require soil analyses, use of precision farming equipment, an increase in working time, and new investments (EP, 2020).

56. The use of mineral fertilizers in the country has been decreasing but their inefficient application seems to be the main issue. According to International Fertilizer Association data, the annual average of total fertilizer consumption in North Macedonia has decreased by 16.3 percent between 2012-2014 and 2018-2019 (Figure 4). This decrease has not been uniform for all types of fertilizer; nitrogen fertilizer consumption has fallen less (-7.3 percent) than that of phosphate (-36.5 percent) and potash (-15.1 percent) fertilizers, respectively.[19] Evidence shows that the use of mineral fertilizers in the country is low compared to the EU average (MAFWE, 2014). However, this is mainly due to the high prices of fertilizers. From an environmental perspective, therefore, the core issue with the use of fertilizers does not relate to the quantities used, but to the frequency, timing, appropriateness, and quality of the mineral fertilizers applied.

57. It is difficult to estimate whether and to what extent farmers in North Macedonia overuse pesticides. According to FAOSTAT, annual pesticide consumption has been constant (at 98 tons) during the 2009-2019 period. This is considerably lower than the 2000-2008 period, when annual average consumption was 222 tons. Until recently, the application of pesticides has been entirely calendar-based, due to the absence of

[18] LEADER is a French acronym that stands for Links between Actions of Rural Development and is designed as a separate axis of the EU Rural Development Program. It aims to mobilize and deliver development in rural communities by encouraging local, innovative responses to rural development rather than through a fixed set of measures. It has proven to be an effective mechanism in driving local development.

[19] In 2019, the share of nitrogen fertilizer in total fertilizer consumption in North Macedonia was 62 percent; the shares of phosphate (21 percent) and potash (17 percent) fertilizers were much lower.

pest- and disease-monitoring systems. However, it has been argued that the estimated level of pesticide residues in the end products is far below the maximum level set by EU standards (Stefanova et al., 2012). As in the case with fertilizers, farmers do not use excessive quantities of pesticides due to high costs and financial limitations.

58. **Although the general use of fertilizers and pesticides in North Macedonia is relatively low compared to EU countries, intensive agriculture, and the transformation of semi-natural pastures into arable land can pose threats to the environment and natural resources.** Diffuse pollution of ground and surface waters with nitrates and phosphates (due to the excessive application of mineral fertilizers and animal manures, especially in highly erosion-prone soils) occurs in areas where there are many intensive farms. Large livestock farms can be sources of water pollution because of the inappropriate use of livestock manure (organic fertilizer), as well as its storage and processing. Pollution from the large industrial pig and poultry farms has declined, but more attention is needed to improve facilities for manure storage on cattle and sheep farms. Water pollution from nitrates and phosphates as well as pesticides and organic manures associated with agricultural production has been reported in the country (Government of North Macedonia, 2021).

59. **Soil quality, soil fertility, and groundwater conditions are mostly affected because of the overuse of fertilizers and pesticides**. Soil fertility problems seriously affect agricultural productivity, and this situation is expected to worsen with climate change. The issues include erosion, soil-born pests and diseases, soil pollution by fertilizers and pesticides, and to a lesser extent salinization and water logging (World Bank, 2014). Also, groundwater pollution in certain regions is an issue, especially in hydro-geologically sensitive areas with a high permeability to groundwater (karst) and intensive use of fertilizers and pesticides.

60. **Further, fertilizer use contributes to GHG emissions.** Direct N_2O emissions from managed soils are mainly caused by intensive inputs of mineral nitrogen fertilizers, manure, and other organic substances as well as urine and dung deposits on pastures during animal grazing on open fields. The shares of these three sources of nitrogen is variable, but from 2005 to 2019, emissions arising from mineral nitrogen fertilizers has increased and prevails over the other two sources (MEPP, 2021c).

61. **Administrative capacity remains weak, and there is no systematic provision of advice, monitoring, or analysis**. Only 5-10 percent of farms in the country record their fertilizer and pesticide use. Despite the availability of GAEC and a rulebook for good agricultural practices on fertilizer use, most holdings apply fertilizer without soil analysis. Also, most farmers are guided by input suppliers on the use of pesticides. As noted by the World Bank (2019b), the capacity of the advisory system leaves a lot to be desired. Inspections are only specific to a small percentage of large farms.

62. **Progress on alignment with EU phytosanitary standards has been good, but further efforts are necessary to implement legislation on plant protection controls and sustainable pesticide use.** The European Commission has highlighted the problem of poor pesticides statistics and the lack of analysis on the risks and impacts of pesticide use on human health and the environment. The Law on Plant Protection Products, adopted in December 2020, is harmonized with EU legislation

related to the sustainable use of plant protection products and placing on market of pesticides. However, actions which are necessary to achieve the sustainable use of pesticides have not been implemented (EC, 2021).

63. **Nationally funded agri-environment measures have been applied but financial outlays have been low and monitoring has been non-existent.** In fact, fragmented initiatives have been more impressive. The "Restoration of the Prespa Lake Ecosystem" (2011–2018) project, financed by the Swiss Government and implemented by the United Nations Development Programme, has helped hundreds of farmers to learn and apply more environmentally sustainable practices and reduce the use of fertilizers and pesticides (UNECE, 2019).

64. **Strategic policy initiatives for the 2021-2027 programming period are heading in the right direction.** IPARD III includes provisions for the sustainable management of farm inputs, including integrated production, organic farming, and manure management, among other things (Government of North Macedonia, 2021). However, this action is targeting only 1,000 ha. A farm investment measure includes specific actions for environmental protection including fertilizer use, and there are also plans to offer advice to farmers on the use of fertilizers and pesticides. Perhaps more important, IPARD III and the National Program aim to support the sustainable use of fertilizers and pesticides with tailored advice and training, through the operational programs for producer organizations and AKIS (MAFWE, 2020). Also, the recently adopted Action Plan on Climate Change (MEPP, 2021a) aims to promote the reduction of fertilizer inputs, through enhanced agriculture practices and the implementation of new technologies. Finally, NARDS foresees improvements in crop production food safety, to be implemented by introducing good hygiene practices and good agricultural practices at the farm level. Mechanisms to protect people against food residues are planned to be established during the 2021-2027 period by introducing the maximum allowed level of pesticide residues in plant and animal origin products and their control, as well as adhering to criteria on the proper use of pesticides. Also, a review of the relevant legal acts is planned and aims to significantly reduce farmers' use and dependence on pesticides, as well as the risks of pesticides and aims to improve integrated pest management.

65. **Further reducing the use of fertilizers and pesticides and a convergence towards EGD targets seems feasible, especially if there are improvements in application efficiency.** North Macedonia State Statistical Office (MAKSTAT) data on sown areas in 2021 and GAEC data on recommended fertilizer application from Northern Greece (Ministry of Rural Development and Food, 2021)[20] show that wheat (due to its large share in total cultivated land), maize, vineyards, and fruit orchards (due to their high rates of fertilization per ha) account for 58.2 percent of fertilizer consumption in the country. If horticulture crops are added, these five types of crops account for 82 percent of total fertilizer use in North Macedonia. A 10 percent reduction in fertilizer use per ha for these crops, induced by an improvement in the relevant advisory services and/or other actions foreseen for the 2021-2027 period, would decrease national fertilizer consumption by 8 percent. Alternatively, lower support and more

[20] Data from Norther Greece are used due to the absence of such data in North Macedonia, as Northern Greece agro-climatic conditions are not so different from those of North Macedonia.

effective agro-technical practices could be considered for low-value crops such as wheat and maize,[21] which together account for nearly 41 percent of fertilizer use in the country. However, the recent food security implications of the war in Ukraine do not currently promote this option. Finally, in the case of pesticides, a reduction of pesticide use in high-value crops such as vines, fruits, and vegetables should be pursued.[22] Hence, as noted elsewhere,[23] an increase in application efficiency triggered by improvements in farm advisory services, use of soil maps and digital technology, and contract farming (which promotes traceability) would lead to a decline in the use of chemicals in North Macedonia's agriculture sector.

Rural Broadband Internet Access

66. The acceleration of structural transformation and promotion of technology adoption and innovation has become increasingly crucial for the economy of North Macedonia. To achieve this, the country needs to overcome weaknesses in connectivity and value chain integration, business development, digital connectivity, and shortages of workforce skills (World Bank, 2019d). Robust ICT infrastructure is a precondition for the transformation of a country, as it provides the foundation for innovative services and economic activity. With the COVID-19 pandemic, countries and communities lacking connectivity faced a greater disruption than those who didn't, thereby raising the overall importance of reliable infrastructure and services that are available to all (ITU, 2021).

67. Although the ICT sector is important in digital transformation, most economic benefits materialize when such technologies are used to transform other sectors. Creating an enabling environment supporting digital innovation is essential to accelerate digital transformation and (ultimately) economic transformation in a country. Through strong digital innovation ecosystems, countries can benefit from increased productivity, economic growth, and employment opportunities and experience a positive impact on the country's broader economic development (OECD, 2021).

68. Agriculture and rural areas are changing significantly with the availability of various modern technologies. The current modernization of economic activities, including agriculture, is inseparably linked to digital technology. The digital transformation of agriculture needs to be imposed as an important factor in the development of the competitiveness of the sector. Hence, there is a need for a strategic approach that includes strengthening the links between AKIS, digitalization, and existing advisory services.

69. North Macedonia has been making steady progress with its broadband internet infrastructure development. In recent years the country has improved its legal and regulatory framework, enabling private sector investments in infrastructure (OECD, 2021). According to the OECD, the country outscores the average in the Western Balkans in broadband access; however, the performance of North Macedonia in other

[21] As suggested in Ministry of Environment and Physical Planning (2014a).
[22] No data has been found on pesticide use per ha for specific crops; however, discussions with the NEA provided an indication on the intensity of pesticide application in various crops.
[23] https://www.fao.org/3/nj164en/nj164en.pdf.

digital sub-dimensions (i.e., use, jobs, society, trust) is lagging that of other Western Balkans countries.

70. **To improve the coordination of broadband development activities, the government adopted a National Operational Broadband Plan in 2019** (NOBP; Republic of North Macedonia, 2021a). Also, a national advisory board for broadband development was created in 2019, the Broadband Competence Office, to support and report on the progress in NOBP implementation. The NOBP promises to connect every household and public institution to high or ultra-high-speed communications networks by 2029. It targets the creation of a nationwide optical backhaul network, 5G infrastructure covering all cities and Next Generation Access (NGA) coverage of white zones (ITU, 2020). During the first year of its implementation, the plan has already shown positive results, especially in planning and accomplishing prerequisites for developing connectivity in under-served areas. The second semi-annual report on NOBP implementation indicates that fixed broadband coverage was at nearly 98 percent in September 2020, higher than the EU average of 97 percent, while fixed broadband take-up was at 73 percent (compared to 78 percent in the EU). However, mobile broadband penetration was almost 65 percent, against the EU average of 100 percent and ultra-fast broadband take-up was slightly above 27 percent, lagging the EU average of 41 percent (Broadband Competence Office, 2020). Rural broadband coverage has advanced in recent years, with almost 70 percent of rural households using broadband connections in 2019, compared to 25 percent in 2011.

71. **The ICT regulatory policy framework is generally aligned with the EU Acquis.** Key EU Directives on ICT have been transposed into the national framework. Legal and regulatory improvements that facilitate an enabling environment for private sector infrastructure investments have been identified. This has happened even for white and grey areas,[24] where interest and profit margins are low. These improvements include regulations on infrastructure and minimizing restrictions on foreign investment in broadband infrastructure. Business models for broadband expansion and the harmonization of state aid rules with EU Acquis in relation to the deployment of broadband networks are being considered (ITU, 2021).

72. **A long-term national ICT strategy for 2021-2025 has been prepared (Republic of North Macedonia, 2021b), but its formal adoption is pending (EC, 2021a).** The ICT strategy aims to deliver a policy that embraces and aligns all other ICT-related policy initiatives, including government digitalization. However, as the strategy is still being prepared, it is not yet certain that it will address the digitalization of SMEs effectively (OECD, 2021). With these efforts, North Macedonia ranked in 72nd place globally on the 2020 e-Government Development Index. Despite a significant improvement of seven positions compared to 2018, this is still low (ITU, 2021).

73. **Citizen access to government services enables productivity, transparency, and equality in digital development.** North Macedonia has made progress in developing digital government, aligned with open government principles and North Macedonia's

[24] In white areas, there is currently no provider of broadband access services and no such provider is expected in the next three years. In grey areas, there is an active (infrastructure-based) provider, however, another network is unlikely to be developed in the next three years (European Commission, 2013).

international digital government commitments (OECD, 2021). At the end of 2019, the national e-services portal was launched, offering electronic services delivered by public institutions (Republic of North Macedonia, 2021a).

74. **Developing digital skills and building human capacities to strengthen employability and create new jobs is essential to both ICT development and economic transformation**. In fact, the COVID-19 pandemic has exacerbated pre-existing inequalities in digital skills (OECD, 2021). The recent COVID-19 experience has exposed disparities between private and public schools and urban and rural areas in the availability of functional computers and portable electronic devices (such as laptops and tablets) and teachers' digital competency and readiness to employ e-learning technology (ITU, 2021). Among peers in the region, North Macedonia has one of the highest numbers of recommended hours for ICT as a compulsory subject in primary education, while continuing professional development in digital education is mandatory. The government has made substantive efforts to strengthen the digital skills development of the country's youth (EBRD, 2021; ITU, 2021). Higher education institutions in the country offer an ICT curriculum and digital skills training for teachers. The purchase and renovation of ICT infrastructure in public schools is underway. There are programs for the development of digital skills for adults, including lifelong learning.

75. **In rural areas, broadband use remains uneven, while infrastructure investments are mainly concentrated around urban areas.** Market failures have led to underinvestment in broadband infrastructure in depopulated rural areas, resulting in considerable regional disparities in access (World Bank, 2019d). Internet service providers see rural broadband infrastructure as unprofitable. In fact, 30 percent of (mostly rural) households are in "white zones", which lack capacities for access to super/ultra-fast Internet, and there are no plans to invest in such networks in the foreseeable future (ITU, 2020). Positive developments in the mobile markets have not been matched by growing use of fixed services or overall use of the internet by the population (ITU, 2021).

76. **High prices for telecommunications and low purchasing power slow the adoption of productivity-enhancing high-speed broadband connections.** The World Bank (2018b) has identified the population's low purchasing power as the main reason for the low penetration of user access to fast and ultra-fast NGA networks (Republic of North Macedonia, 2020b). High retail prices (in relation to average income), high wholesale prices, and limited competition and investments are major barriers to the development of broadband penetration in the country (Broadband Competence Office, 2020; ITU, 2021). These gaps in affordability suggest increased inequality in access to ICTs and connectivity and therefore, the potential for a widened digital divide between low- and high-income households.

77. **Low uptake is also attributed to the non-competitive structure of both retail and wholesale telecommunications markets in the country.** Market concentration is high in all Western Balkan countries, but North Macedonia ranks second highest (World Bank, 2018b). Indicatively, the market share of a single retail operator is more than 40 percent in both fixed- and mobile telecoms markets (ITU, 2021). The wholesale broadband market is also highly concentrated with few providers, which deters competition and investment in the sector.

78. **North Macedonia lacks a coherent policy framework to directly support private sector ICT adoption**. The Innovation Strategy and corresponding fund, and the other SME or sectoral policies do not envisage financing ICT adoption. There have been tax incentives for purchasing software and hardware, and voucher schemes have been implemented, but these have not been sufficient to support private sector adoption of ICT (OECD, 2021). Even though ICT is one of the fastest growing SME sectors, the absorption of technology by SMEs from other sectors remains low. To improve SME competitiveness, the government has enacted the 2018-2023 Strategy on Competitive SMEs which establishes a framework for public, private, and civil society actors to collaborate in support of SME development and innovation. One part of the strategy is dedicated to dynamic entrepreneurship and an innovation ecosystem (ITU, 2021).

79. **Investment conditions and market attractiveness do not seem conducive for the advancement of ICT.** According to the European Bank for Reconstruction and Development (EBRD, 2021), North Macedonia is a small market for ICT, with forecast growth rates of 3.2 percent per year for fixed broadband and 0.7 percent for mobile broadband. Investment uncertainties remain. Access to spectrum resources, alongside taxation, state assistance, limited availability of skilled labor, and uncertainty in the granting of construction permits contribute to broadband investment risk. Spectrum fees are very high in North Macedonia, where mobile operators pay relatively high sums in comparison to other markets in the region (ITU, 2020; 2021). Future spectrum plans appear to maintain the current spectrum management approach of high costs. There is a view that the spectrum management strategies adopted by the government should be better harmonized within the overall context of a wider ICT strategy (ITU, 2021).

80. **Skills shortages constrain the development of the ICT sector.** Staff skilled in ICT are attracted by large multinationals or move to richer countries. The level of wages required to attract and retain staff is not generally possible within ICT companies operating in a domestic market with relatively low spending power among consumers (EBRD, 2021).

81. **There seems to be a good basis for the introduction of digital technologies in agriculture in North Macedonia, but higher capacity should be built.** Farmers have significant know-how when it comes to using ICT devices such as smartphones (55 percent), computers (70 percent), and the internet (60 percent). However, farmers have little knowledge about more advanced ICT technologies, such as automated systems, GPS, and other tools for precision agriculture. In addition, farmers have little or moderate awareness of the impact of smartphones on agribusiness, even though the devices are widely used in rural areas. More capacity building support is needed to ensure a digital ecosystem supporting this sector (ITU, 2021).

82. **North Macedonia authorities should pursue all necessary actions to develop a modern, competitive, and inclusive broadband network in the country.** The key role of the state is to establish a clear and coherent policy for broadband, with an investor-friendly legal and regulatory framework for the broadband market promoting investment without undue barriers. Key examples of these barriers are high levels of taxation on the sector and high charges for access to government-managed resources, such as spectrum. Other barriers include the availability of labor with digital skills and state assistance and funding schemes.

83. **Supply-side policies should aim to create an enabling environment.** Policy initiatives should improve conditions for private sector investment to expand high-speed broadband access to under-served areas, improve international competitiveness, open new job opportunities, promote social inclusion and territorial cohesion, and facilitate integration into the Western Balkan Digital Highway (World Bank, 2019d). Network expansion would improve through lowering broadband tariffs, tightening regulation, and encouraging additional supply. Enhancing competition could reduce prices and speed adoption of broadband connections. Cooperative models involving network and infrastructure sharing, joint cost ventures and greater cooperation of civil works could be introduced to promote market effectiveness. Effective state-aid rules and mechanisms need to be in place to achieve policy objectives where these cannot be met by commercial investments alone. State funding schemes should promote cost-effective solutions and avoid distorting effects. Permit-granting procedures should become faster, simpler, and more transparent.

84. **Public intervention is necessary to realize the benefits of broadband that cannot be achieved through the market mechanism alone**. The government's ICT strategy should clearly specify approaches to addressing failures in rural markets, such as using public co-financing to crowd-in private investments.

85. **Facilitating ICT adoption by private firms should be a key element of public policy.** Access to finance for the encouragement of the digital economy should be facilitated and additional support (through co-financing with increased intensity in relation to other eligible costs) and services to the digitalization of SMEs should be provided. Firms' capabilities and capacity for technology adoption should be strengthened to facilitate improvements in productivity and competitiveness. Upgrading labor skills should be further pursued, especially for adults. Incentives should be provided to companies to undertake ICT training of their staff.

86. **A comprehensive approach is needed to support agricultural and rural digitalization**. Successful efforts to increase rural broadband coverage should continue and policy initiatives on firms' ICT adoption and skills upgrade should be distinct for rural areas. The adoption of precision farming requires specific equipment and broadband coverage to monitor the spraying of pesticides and the spread of fertilizers to better fit the exact needs of the plants in the field. Hence, precision agriculture should be supported for a more efficient use of resources and the introduction of more effective management systems. These will contribute to an upgrade in the economic and environmental performance of North Macedonia's agriculture sector. The same goes for the digitalization of the agri-food chain, through technology which would improve the transparency and traceability of quality standards. Digital technologies should be used to support AKIS, knowledge exchange, training, and advisory services. ICT solutions based on evidence should support agricultural policy design and implementation. AKIS activities should include special training for farmers and advisors, to facilitate the use of ICT in the sector.

Protected Areas

87. **North Macedonia has been moderately active in the development and management of protected areas.** The designation of protected areas started in 1948, and most protected areas were proclaimed between the 1960s and 1980s. Currently, 86 protected areas have been designated in accordance with the Law on Nature Protection. There are 2 nature reserves, 3 national parks, 67 monuments of nature, 12 nature parks, 1 protected landscape and 1 multi-purpose area. Two sites are included in the Ramsar List:[25] Lake Prespa (1995) and Lake Dojran (2008). Currently, there is an initiative to nominate Lake Ohrid as a Ramsar site. Protected areas cover about 9 percent of the country's territory (MEPP, 2018b). Progress in protected area reclamation has been slow; the share of designated areas in the overall area of the country was 7.14 percent in 1990 and grew to 8.94 percent in 2017. This is well below the minimum value of at least 17 percent by 2020 indicated in the Convention on Biological Diversity (CBD) Aichi Biodiversity Target 11. Also, the number of designated areas increased from 67 in 1990 to 86 in 2017, 67 of which are natural monuments. Three national parks correspond to 50 percent of the country's protected areas.

88. **The 2004 Law on Nature Protection constitutes the legal basis for the designation of protected areas.** Following the International Union for Conservation of Nature (IUCN) categorization, the law regulates the protection of natural habitats, biodiversity, and natural heritage. In recent years, it has been harmonized with three of the EU's main instruments for the protection of nature, the Habitats Directive (92/43/EEC), the Birds Directive (79/409/EEC), and the Regulation on the Protection of Wildlife and Fauna. However, several by-laws are still awaiting adoption, which requires significant effort and scientific work (MEPP, 2018b). Other main relevant legislation includes the Law on Agriculture and Rural Development which regulates agro-biological diversity and provides support for genetic diversity conservation (MEPP, 2018b). In addition, in 2018, the Government adopted the National Strategy for Nature Protection and the Action Plan for 2017-2027, as well as the National Strategy for Biological Diversity and the Action Plan for 2018-2023. In 2020, the sixth national report to the Convention on Biological Diversity was prepared.

89. **The harmonization of the Law on Nature Protection with the EU Acquis has introduced a restructuring process of the country's system of protected areas.** The amended law[26] requires the reproclamation of all protected areas. This process starts with the preparation of a valorization study for a protected area and continues with proclamation and the preparation of a management plan. The subsidiary legislation governing the preparation of a valorization study and management plan is in place.

90. **The existing set up for nature conservation is mainly centralized within government institutions.** The MEPP is responsible for actions on the environment and nature protection. The Department for Nature is responsible for the development of policies and provision of technical expertise in the development of legislation and oversees policy implementation in the fields of biodiversity and landscape diversity,

[25] https://ramsar.org/about-the-convention-on-wetlands-0
[26] The Law on Nature Protection has been amended no less than 17 times since 2011 (MEPP, 2018b).

protected areas, and natural heritage. The National Committee for Biological Diversity monitors the implementation of the Convention on Biological Diversity in the country. Also, MAFWE has an important role in the conservation and sustainable use of biological diversity through its functions on forest protection, fishing, hunting, organic farming, agro-biological diversity protection, rural development, and plant and animal protection. Few competences have been delegated at the local level; however, public institutions (at the local level) have been appointed as management entities for protected areas (MEPP, 2018a).

91. **The protected areas system in North Macedonia is still under development.** The initial proclamation of protected areas did not adequately consider threats to habitats and species. Areas were proclaimed at different levels (national or local), boundaries were not clearly defined, management entities were not nominated (except for the three national parks), and management objectives were not clearly specified. Amendments to the Law on Nature Protection led to proclamations under different categories and with different goals. Consequently, the country's protected areas network is not considered coherent (MEPP, 2018a) and does not ensure ecological continuity and connectivity, as linking ecological corridors is lacking. The process of revalorization and re-proclamation of existing protected areas has been facing delays**.** Despite initial plans to complete this process by 2011, this process is still pending for several protected areas, with some of them considered important (MEPP, 2018a; EC, 2021a). This delay impedes the proper delineation of the areas, as well as the preparation and adoption of required management plans. A land cadastre to allow the determination of land use and land ownership, and a national inventory of forest resources are lacking.

92. **But some progress is evident.** In 2015, North Macedonia started the process of identification of potential future sites of "Natura 2000". First, a draft national reference for habitats, species, and birds was developed, and pilot areas were identified. The next step covers the preparation of management plans for identified Natura 2000 areas, updating of the national habitats, species, and birds reference list, practical use of habitats, species, and birds monitoring protocols in field activities and the adoption of additional by-laws. According to the EC (2021a), progress has been made on this front, facilitated by the Instrument for Pre-Accession (IPA) projects on strengthening capacity for the implementation of Natura 2000 and for the effective implementation of the Acquis in the field of nature protection. In fact, according to the 2018 National Biodiversity Strategy, the identification of potential Natura 2000 sites should be completed by the end of 2022.

93. **Institutional capacity and coordination are weak**. The management authorities of protected areas are weak, particularly in terms of expertise and funding. The operations of national parks largely depend on their own revenue that is derived from the use of natural resources or external (donor) financial support, while most protected areas of other categories have neither a budget nor a management body. The Department for Nature faces a lack of both capacity and financial resources to implement relevant legislation and other tasks such as the planning, establishment, and supervision of protected areas. Overlaps and poor coordination between the MEPP and MAFWE exist, and monitoring of nature protection action is poor (EC,

2021a). Also, the integration of environmental issues and requirements on sectoral policies (including agriculture) has been rather poor (UNECE, 2019).

94. **Important policy targets have not been fulfilled.** The 2018-2023 National Biodiversity Strategy and Action Plan concludes that only 29 percent of activities of the 2003-2013 Strategy and Action plan were achieved; around 26 percent were partially realized, and 44 percent were not realized at all. Major constraints include the lack of financial resources; low prioritization of biodiversity conservation; lack of capacity in the MEPP; insufficient coordination and cooperation between Ministry departments, as well as with other relevant Ministries such as MAFWE; and slow procedures for the proclamation of new protected areas (MEPP, 2018b).

95. **Legislative gaps are evident.** The Law on Nature Protection provides a solid legal basis, but several of its provisions are not clear. These include clauses on the temporary protection of species and areas that undergo the procedures of valorization and proclamation, the determination of bodies responsible for temporary protection and of relevant administrative actions.

96. **The National Strategy for Nature Protection and Action Plan for 2017-2027 and the National Biodiversity Strategy and Action Plan for 2018-2023 have set new ambitions for protected areas in the country**. Strategic goals include: (i) overcoming the root causes of loss of biodiversity through its integration across the whole society; (ii) reducing direct and indirect pressures on biodiversity; (iii) improving the status of biodiversity by conserving ecosystems, species, and genetic diversity to increase the benefits of biodiversity and ecosystem services; and (iv) improving the knowledge and availability of information on biodiversity. However, harmonization is required regarding timelines set for the same activities, which sometimes differ between the two strategies. Various institutions and organizations are involved in activities for biodiversity conservation and nature protection. However, concerted efforts to coordinate activities between the MEPP and other sectors, such as forestry, agriculture (including organic), transport, energy, and tourism, are lacking. Also, the coordination and enforcement capacity of Environmental Inspectorates needs to be further strengthened.

97. **Managerial capacity should improve, and fiscal resources should be specified**. The capacity of the entities in charge of protected areas is insufficient to ensure adequate management. Data collection, monitoring, and analysis systems should be established in an integrated manner. Material and human resources should be upgraded at both the national and local levels. A separate government budget line should earmark funds for the management of protected areas, including management plans and action on harmonization with the relevant EU legislation. Payments for ecosystem services in protected areas should be established to facilitate financial sustainability. Public awareness of ecosystem services provided by protected areas and local community involvement in management of protected areas should be strengthened.

98. **The Natura 2000 framework should be utilized with an aim to generate a coherent network of protected areas and approximate the relevant EGD target.** Considering the EU-accession prospects of the country and the current fragmentation

of the proclamation of protected areas, pursuing coherence with Natura 2000 provisions could lead to a more comprehensive, effectively managed, and viable protected areas system in the country. Within this context, currently available plans which could lead to the extension of the national protected areas network should be utilized. In fact, the incorporation of the Macedonian Ecological Society National Ecological Network proposal which encompasses around 20 percent of the country's territory in the National Biodiversity Strategy and Action Plan for 2018-2023 is a step in the right direction.

GHG Emissions from Agriculture

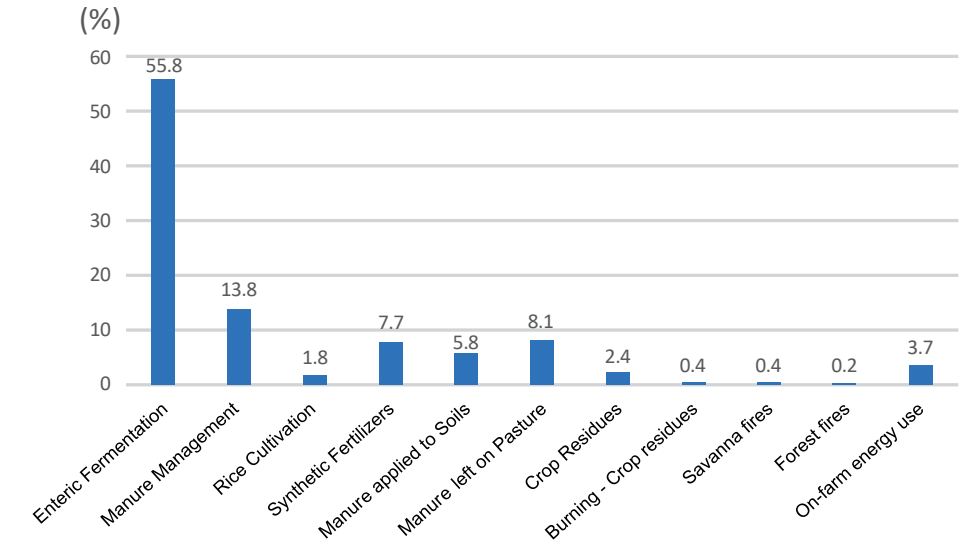
99. The share of agriculture in total GHG emissions in North Macedonia is 9.2 percent (2021). Since the mid-2010s, this share has declined slightly.[27] In 2017-2019, 77.6 percent of agriculture sector emissions were a consequence of livestock production activities, mainly enteric fermentation, manure management, and manure left on pastures (Figure 6). Consequently, about 80 percent of these emissions are CH_4 (UNECE, 2019). Other notable sources include synthetic fertilizers (7.7 percent) and on-farm energy use (3.7 percent). CH_4 emission is caused by enteric fermentation during herbal digestion in ruminants and N_2O emission occurs during the metabolic processes. Additionally, N_2O is emitted because of manure storage and processing (management). GHG emissions from crop production are generated by inadequate or excessive fertilization with mineral fertilizers, infrequent and inadequate application of manure, inadequate management of arable land and improper management when fertilizing (MEPP, 2020; 2021c).

100. Compared to 1990,[28] agriculture emissions in North Macedonia have decreased by 25.7 percent, mainly due to the decrease in livestock. On-farm energy use has recorded the sharpest decline (63.2 percent), followed by rice cultivation (54.4 percent), manure left on pastures (44.3 percent), and synthetic fertilizers (36.4 percent, see Figure 7). The reduction of emissions associated with the most significant contributor, that of enteric fermentation (20.8 percent) was much lower. Also, emissions from another important source, that of manure management have increased by 2.7 percent between 1990 and 2017/19.

[27] http://makstat.stat.gov.mk/PXWeb/pxweb/en/MakStat/MakStat__ZivotnaSredina/275_ZivSr_nac_stak_gas_proekcii_ang.px/table/tableViewLayout2/?rxid=b795ef6d-4823-43f5-b7ce-e4237f81ad5a.

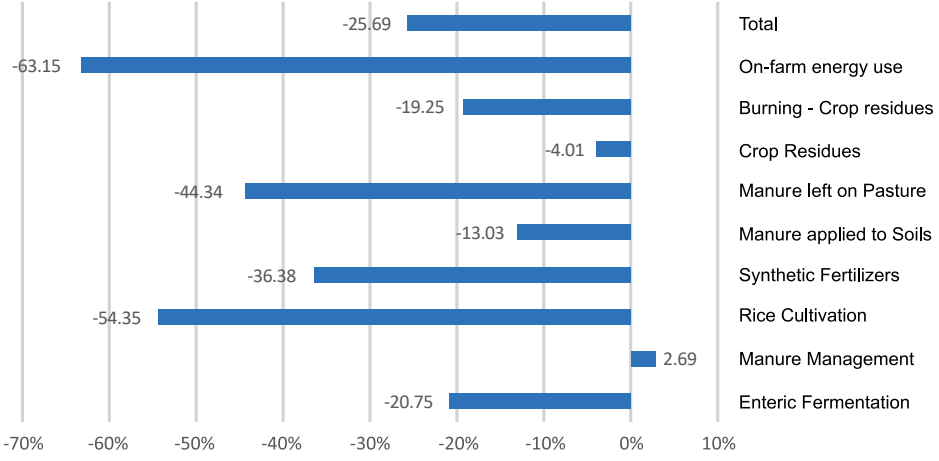
[28] Reference year for the EGD and United Nations Paris Agreement.

Figure 6. Agriculture emissions by source, North Macedonia, 2017 – 2019 (%)



Source: FAOSTAT.

Figure 7. Percentage change of agriculture emissions by source, North Macedonia, 2017 – 2019/1990 (%)



Source: FAOSTAT.

101. **North Macedonia has been making progress with its commitments to reduce GHG emissions.** At the 2015 Paris Climate Summit, the country committed to reducing GHG emissions by 36 percent by 2030 compared to the 1990 baseline scenario (United Nations, 2020). The 2021 Long-Term Strategy on Climate Action (MEPP, 2021a) committed to a reduction of national net GHG emissions of 72 percent

by 2050 compared to 1990 levels or to GHG emission reduction of 42 percent by 2050 compared to 1990 levels. By the end of 2021, North Macedonia communicated an enhanced nationally determined contribution (NDC) to the global efforts for GHG emissions reduction, committing to an 82 percent reduction of net emissions and a 51 percent reduction of GHG emissions by 2030, compared to 1990 levels (MEPP, 2021b). The NDC and Climate Strategy include 63 mitigation policies and measures (PaMs), including agriculture for which GHG emissions reduction targets of 29 percent and 34 percent are set for 2030 and 2050, respectively. Considering GHG emissions reductions in agriculture fulfilled by 2017-2019, these targets do not seem ambitious. The Strategy encompasses mitigation actions such as carbon pricing, pursuing regional energy markets integration, strengthening the role of SME, PaMs in research and innovation, and other measures. Also, there are provisions on progress indicators to monitor implementation.

102. **One of the main objectives of the Climate Strategy is on agriculture.** Objective 3 aims to reduce GHG emissions in agriculture through the adoption of measures that contribute to sustainable agriculture, increased carbon sequestration in the soil (due to increased organic matter), increased efficiency in milk production, and reduced fertilizer input through enhanced agriculture practices and implementation of new technologies. The 2000-2016 rate of conversion of land is assumed to hold by 2040. In livestock, the current state of productivity and farm management methods are maintained over the entire planning period.

103. **Measures proposed for agriculture seem to have been determined by national rather than sectoral GHG emission priorities.** Measures on livestock include a 3 percent reduction of CH_4 emissions from enteric fermentation in dairy cows, to be achieved through the modification of feed content and nutrition management; a 20 percent reduction of N_2O emissions from manure management in dairy cows; a 13 percent reduction of N_2O emissions from manure management in swine farms; and a 20 percent reduction of N_2O emissions from manure in dairy cows for farms below 50 livestock units. Measures on other land uses include the conversion of field crops above 15 percent inclination into perennial grassland; contour cultivation on areas under field crops on inclined terrains; perennial grass in orchards and vineyards on inclined terrains; use of biochar for carbon sink on agricultural land; and photovoltaic irrigation.

104. **The commitment of financial resources does not seem ambitious enough and their distribution does not seem cost-effective.** Total investment costs for measures directed solely to reduce GHG emissions in agriculture amount to EUR 102 million by 2040.[29] This corresponds to a little bit less than the annual average budget for direct payments over 2021-2027 (MAFWE, 2020). IPARD is specified as the sole source of funding, despite the significant increase foreseen for national rural development support over 2021-2027. The cost effectiveness of policy measures varies significantly; measures on livestock emissions achieve a reduction of 14.45 Gg CO_2 -eq per million Euros spent by 2040, while the equivalent ratio for other land use

[29] These calculations do not account for the cost of policy measures which will also contribute (directly or indirectly) to GHG emissions reduction, namely aiming at fertilizer- and pesticide-use reduction, high-diversity agricultural landscapes, rural broadband, investment support, innovation, knowledge, advisory services, etc.

measures is much lower (5.90 Cg CO_2-eq per million Euros spent). Indicatively, it is perhaps odd that only EUR 300,000 are allocated for the reduction of emissions from enteric fermentation in dairy cows, as in the case of this measure, every million Euros spent reduces emissions by 211 CG CO_2-eq.

105. **There are barriers to the implementation of adaptation measures in the agriculture sector.** The dependence of agriculture on smallholders and the dominance of small agricultural plots, coupled with a low level of awareness about the effects of climate change among key actors in the sector, hinder the fully effective implementation of adaptive measures (UNECE, 2019). Another barrier is the insufficient support to farmers to cope with the negative impacts of climate change (MEPP, 2014a; 2014b). However, perhaps the most important barriers are shortages in farm infrastructure investments, technology adoption, and technical capacity and know-how which would enable farmers to pursue adaptation actions.

106. **Institutional capacity is rather weak.** While the existence of an inter-ministerial coordination mechanism on climate change is worthwhile, participating Ministries (such as MAFWE) do not have units/departments dedicated to climate change. Therefore, the lack of adequate specific structures and resources in terms of sufficient and qualified staff, illustrates the constrained capacities of the Ministries on climate change. This is likely an obstacle to effective cooperation on climate action.

107. **Policy initiatives pursuing a reduction of agriculture emissions should be more ambitious and attempt to integrate a wider range of complementary actions.** Climate risks are expected to affect agricultural production in the country (e.g., World Bank, 2014) and this surely justifies higher emission reduction targets, a larger financial envelope, a re-examination of financial resources distribution, and the prioritization of policy measures which are both targeted and cost-effective. Policy action supporting digital agriculture, energy efficiency, investments in climate resilient agriculture, improving the resilience of farmers to climatic shocks through insurance, value chains management, and technological advances should be prioritized.

108. **It is important to mainstream climate change-related aspects into future national strategic planning documents related to education, research and development (R&D), and innovation.** This would assure the systematic integration of climate-related aspects into the national educational, R&D, and innovation ecosystem, as well as increase educational and research capacities and climate awareness.

109. **The development and implementation of skill-building programs related to sustainable technologies (professional upgrading, vocational training, lifelong learning) should be prioritized**. This would unlock the potential for the creation of green jobs and a low-carbon economy. An enabling legal framework and incentive mechanisms for domestic producers should support climate-friendly technologies.

110. **The implementation of climate change policies and measures requires comprehensive policy planning, coordination, and implementation capacities and processes**. Institutional structures and resources should be strengthened. As

climate action is cross-sectoral, public responsibilities need to be shared and effectively coordinated. A comprehensive legal basis and legally established coordination instruments should facilitate cross-sectoral policy design and implementation, as well as mechanisms for monitoring policy implementation. The draft Law on Climate Action provides an enabling environment for policy coordination processes and defines the legal mechanism for the monitoring and evaluation of progress toward the achievement of national climate targets (MEPP, 2021a). Coordination by the National Climate Change Committee (NCCC), which aims to provide high-level support and guidance for overall climate change policies, has not been successful so far (MEPP, 2020). The status of NCCC is currently being revised within the draft Law on Climate Action as an advisory body, which shall provide high-level support and guidance for overall climate action in the country as well as to contribute to the integration of climate action in sectoral policies, plans, and measures.

IMPACTS OF GREEN PRACTICES ON FARM PERFORMANCE IN NORTH MACEDONIA

Introduction: Methodology and Data Issues

111. **This section presents an analysis of farm efficiency in North Macedonia.** It utilizes the most recently available (2018) individual-farm FADN national dataset, to estimate the current technical efficiency (TE) of farms in the country and to assess the impacts of drivers associated with current production practices and the agriculture policy support mix. Subsequently, estimates are derived on farm performance differentials associated with the application of production methods of different levels of input intensity. In this way, the potential impacts of both sustainable farming practices and greening agriculture support on farm efficiency can be approximated.

112. **Efficiency analysis at the farm level provides a framework for assessing the relative output performance of agricultural holdings in terms of the use of inputs.** The TE of each farm is computed with reference to the best performing or best practice farms in North Macedonia, which define the production frontier. The analysis defines efficiency as the proportionate reduction of inputs that a farm can achieve while maintaining its level of output, using the available production technology. It provides a rich set of estimations of both simple and bias corrected TE, as well as of scale efficiency (SE) scores.[30] With respect to additional characteristics of the production technologies, Variable and Constant Returns to Scale (VRS and CRS, respectively) versions of the frontier have been estimated.

113. **The analysis is based on a multi-input, multi-output distance function and adopts non-parametric estimation techniques, specifically the Data Envelopment Analysis (DEA) approach and correcting for bias.** One of the DEA advantages is that the approach does not impose any restriction on the functional form of the technology set, while its main alternative, the Stochastic Frontier approach, requires both an assumption of the functional form of the technology and strict assumptions on the distribution of the efficiency term. However, DEA does not consider the noise in data (Simar and Wilson, 1998; 2000), which may result in an underestimation of the efficiency of analyzed farms. To address this limitation, a two-stage bootstrapped DEA was used for this analysis and the results present bias-corrected TE (bcTE) scores.

114. **Individual farm data from the 2018 FADN is used for the efficiency analysis**. A sample with 595 observations[31] is used. Two outputs are considered: (i) the total output of crops and crop products and (ii) the total output of livestock and livestock products. Five production factors are considered: (i) labor input, (ii) total UAA, (iii) total specific costs, (iv) total farming overheads, and (v) total assets.[32]

[30] Conceptually, Technical Efficiency captures managerial competencies, effectiveness of organizational routines and adjustment to business environment, and regulatory framework. Product, organizational, and marketing innovation matters. Scale Efficiency reflects the influence of technology compatibility and lumpiness, market size, scale decisions, and irreversibility of investments. Process innovation is crucial.

[31] The 2018 FADN sample consists of 610 observations (farms). Of those, 15 farms exhibit negative output values or zero values for the input of land. These farms were excluded. Hence, the final sample used for the analysis contains 595 observations.

[32] All the variables, except labor and land inputs, are measured in monetary values. Labor is measured in time worked in hours by total labor input on holding, while the land input is measured in hectares.

115. **Farm heterogeneity specific to the objectives of this study is considered in the efficiency estimations.** Two distinct specifications are utilized, reflecting different production sustainability orientations. First, the assessment considers the whole 2018 FADN sample, followed by estimates on a sub-group of low input-intensity farms.[33] Production efficiency differentials are estimated to reflect a series of farm characteristics for the whole 2018 FADN sample. Farm-type classifications are utilized, reflecting differences in economic size, subsidization status, production orientation, farm manager characteristics, and regional location. Five categories of support are considered to assess the differential performance of farms: (i) total subsidies excluding on investments; (ii) subsidies on investments; (iii) subsidies on crops; (iv) subsidies on livestock; and (v) subsidies on industrial crops.[34] In terms of economic size, four size groups are considered. Micro farms have an economic size between EUR 2,000 and EUR 4,000. Small farms are those with an economic size between EUR 4,000 and EUR 8,000, while medium-sized farms have an economic size between EUR 8,000 and EUR 15,000. Large farms are those with an economic size exceeding EUR 15,000. In the case of farm manager characteristics, two classifications were used: first, on age, with farmers up to 40 years old classified as "young" and the rest as "experienced"; and second, FADN data on farm managers' training experience was utilized to define three groups of farmers, those with: (i) practical experience, (ii) basic training, and (iii) full training. In terms of production orientation, farms were grouped according to the TF classification[35] defined by EU Regulation 1242/2008. Three farm typologies, in terms of production orientation, were defined: (i) specialist crops; (ii) specialist livestock; and (iii) mixed farms. In addition, six geographic regions were defined based on the country's administrative classification: (i) Skopje, (ii) Bitola, (iii) Kumanovo, (iv) Stip, (v) Tetovo, and (vi) Strumica.

116. **The productive performance of farms with a seemingly higher sustainability orientation is estimated separately.** North Macedonia FADN sample farms were classified into three groups, based on different levels of input intensity. Based on the definition of the Farm Input Intensity Context Indicator by the EC,[36] which expresses input intensity as the ratio of input (fertilizers, pesticides, other crop protection products, and purchased feed) purchases per ha of UAA, farms were classified into three groups of the same size, namely, (i) high intensity, (ii) medium intensity, and (iii) low intensity. This choice enables an attempt to assess if farms which are closer to the green growth concept are associated with a higher (or lower) productive performance in comparison to the average. It also enables an assessment of the determinants of their performance, including their structural characteristics and different types of public intervention.

117. **The second stage of the analysis assesses efficiency drivers, estimating regression models with a set of explanatory variables.** Explanatory variables include those already presented above, plus ratios of subsidies per ha of UAA.

[33] More detail is provided below.
[34] Due to the importance of tobacco in North Macedonia agriculture.
[35] For more information on farm typologies and FADN variables see: http://ec.europa.eu/agriculture/rica/detailtf_en.cfm?TF=TF14&Version=13185.
[36] https://agridata.ec.europa.eu/Qlik_Downloads/InfoSheetEnvironmental/infoC33.html.

Results for Technical and Scale Efficiency

Production Efficiency Differentials

118. North Macedonia farms are characterized by technical inefficiency and polarization. The bias corrected scores (bcTE)[37] are low and present a significant variation—the mean efficiency score is 0.441 indicating that the average farm in the sample can produce the same output using 66 percent fewer inputs, given the available production technology. The minimum value of bcTE is 0.111 (very inefficient) while the maximum is 0.842 (quite efficient). TE distribution indicates a polarization phenomenon in North Macedonia (Table 2 and Figure 6). Around 57 percent of sampled farms seem to be comparatively quite inefficient, with their bcTE score not exceeding 0.4. In parallel, about 24 percent of farms seem to be performing quite well, exhibiting a high TE (bcTE score exceeds 0.6). Almost two-thirds of the sample farms could produce the same level of output employing half the of the inputs they currently use. This could mean that farms are using too many inputs or/and an increase in input prices is making inputs too expensive considering the value of generated output.

119. North Macedonia farms are able to exploit the potential of employed technology. They have adjusted their scale towards the optimal, most productive scale and hence, they operate well in terms of the returns to scale of technology. The mean SE is considerably high (0.762), indicating that the average farm in the sample can operate at the optimal scale by adjusting its input scale by only 24 percent. Despite the large range of SE (the minimum and maximum values of SE are 0.089 and 1 respectively), over 56 percent of the sample farms have an SE score exceeding 0.80 (Table 2 and Figure 8). The high performance of North Macedonia farms with respect to scale economies should be interpreted in the context of the experience of producers, which allows them to utilize their knowledge when scale decisions are made.

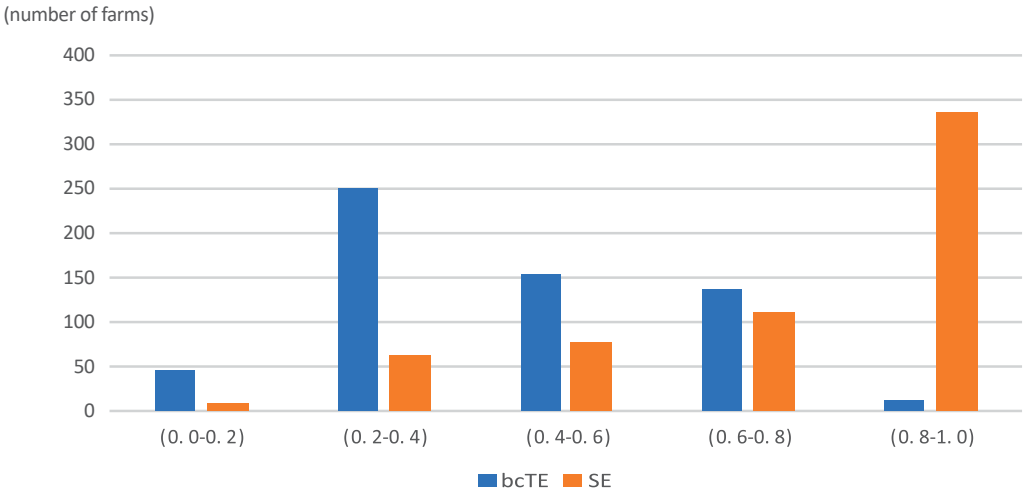
Table 2. Frequency distributions of bcTE and SE, North Macedonia, 2018

Range of scores	Technical Efficiency (bcTE)			Scale Efficiency (bcSE)		
	Number of Farms	%	Cumula-tive %	Number of Farms	%	Cumula-tive %
(0.0-0.2)	45	7.56	7.56	8	1.34	1.34
(0.2-0.4)	249	41.85	49.41	63	10.59	11.93
(0.4-0.6)	153	25.71	75.13	77	12.94	24.87
(0.6-0.8)	137	23.03	98.15	111	18.66	43.53
(0.8-1.0)	11	1.85	100.00	336	56.47	100.00
Total	595	100.00		595	100.00	

Source: World Bank staff calculations.

[37] The difference between bias corrected and bias non-corrected technical efficiency scores under variable returns to scale is statistically significant; therefore, bias corrected VRS technical efficiency scores are used, hereafter denoted as bcTE. The mean value of the non-corrected technical efficiency was found to be equal to 0.541.

Figure 8. Frequency (number of farms) of bcTE and SE, North Macedonia, 2018



Source: World Bank staff calculations.

120. Subsidized farms perform worse than non-subsidized farms. Farms receiving any type of subsidy have comparatively lower TE scores[38] (bcTE: 0.434) than non-subsidized farms (bcTE: 0.525)[39] (See Table 3). This finding holds for farms receiving crop subsidies (bcTE: 0.415 compared to those not receiving them 0.441), while a larger differential is observed for farms receiving subsidies for industrial crops (bcTE: 0.333 vs 0.459). For farms receiving livestock subsidies, findings show that subsidization does not affect farm performance in a negative way. The provision of rural development support investments and livestock subsidies does not seem to be linked to any TE differentials between subsidized and non-subsidized farms. In the case of rural development, this contrasts with findings for Serbia (World Bank, 2018a) and shows that this type of support does not lead to improvements in productive performance. However, it is similar to findings on Croatia (World Bank, 2019a), which indicate that subsidies inducing technological progress could contribute negatively on TE. This so-called productivity paradox means that the adoption of new technologies using subsidy grants, may result in, at least in the short run, significant adjustment costs mainly attributed to the organizational and human capital features of the farm. Policies aiming at the reduction of technology adoption adjustment costs may be valuable in such cases.

[38] Average TE and SE scores presented here for different farm groups do not imply causal relationships between farm characteristics (e.g., economic size, production orientation, subsidization status, etc.) and efficiency performance. Causal relationships are analyzed subsequently through drivers' analyses.

[39] The hypothesis (Ho) that the subsidized and non-subsidized farms have equal sample means of their corresponding bias corrected technical efficiency is tested. Similarly, the assumption that the scale efficiency of the subsidized farms equals the scale efficiency of the non-subsidized farms was tested. Results are extremely robust and available upon request.

121. In the case of SE, results are mixed. Farms receiving any type of subsidy (SE: 0.766 vs 0.697), subsidies on crops (SE: 0.797 vs 0.742), and subsidies on industrial crops (0.855 vs 0.745) perform better than the corresponding non-subsidized farms in terms of SE. This perhaps implies that supports granted[40] provide the necessary resources, which in turn enable better scale and technology decisions. In the case of livestock subsidies, subsidized and non-subsidized farms do not seem to differ in terms of their SE performance. Finally, farms receiving rural development support for investment perform worse than those that do not receive this type of support (SE: 0.693 vs 0.787), most likely due to credit and cash-flow constraints also induced by the fact that they must contribute their own resources to public support for investments. Rural development support does not seem to link to better scale and technology decisions. As in the case of analyses for both Serbia and Croatia (World Bank 2018a; 2019a), this could be attributed to either credit constraints and/or to the time-lag needed until rural development investments result in significant improvements to farm scale performance.

Table 3. Differences of bcTE and SE between subsidized and non-subsidized farms, North Macedonia, 2018

		Technical Efficiency			Scale Efficiency		
Type of subsidy	No. of subsidized farms (non-subsidized)	Mean of bcTE of subsidized farms (non-subsidized bcTEns)	t-statistic w.r. to bcTE (p-value)[41]	Average bcTE of subsidized farms compared to the average bcTE of the non-subsidized farms	Mean SE of subsidized Farms SEs (non-subsidized SEns)	t-statistic w.r. to SE (p-value)	Average SE of subsidized farms compared to the average SE of non-subsidized farms
Total subsidies	552 (43)	0.434 (0.525)	3.118 (0.003)	Smaller	0.766 (0.697)	1.937[42] (0.058)	Greater
Subsidies on investment	161 (434)	0.439 (0.441)	0.149 (0.881)	Equal	0.693 (0.787)	4.229 (0.000)	Smaller
Subsidies on crops	218 (355)	0.415 (0.448)	2.127 (0.033)	Smaller	0.797 (0.742)	-2.762 (0.006)	Greater
Subsidies on livestock	115 (156)	0.432 (0.407)	-1.032 (0.302)	Equal	0.822 (0.781)	-1.423 (0.155)	Equal
Subsidies on industrial crops	87 (508)	0.333 (0.459)	7.622 (0.000)	Smaller	0.855 (0.745)	-5.633 (0.000)	Greater

Source: World Bank staff calculations.

[40] These are rather high in North Macedonia compared to other Western Balkans countries and especially for crops and industrial crops (World Bank, 2019c).

[41] p-values reflect the probabilities of error type I and are referred to in the hypothesis (Ho) that the mean efficiency of the group is equal to the mean efficiency of the remaining subgroups. Z-test and Kolmogorov–Smirnov test have resulted in the same decisions.

[42] At a significance level of 10 percent.

122. **Medium-sized farms are the least technically efficient farms in North Macedonia, indicating a "missing middle" phenomenon.** Micro farms exhibit superior productive performance in terms of TE (bcTE: 0.499; Table 4). On the other hand, medium-sized farms perform worse (bcTE: 0.368), indicating a case for a "missing middle". These findings are in accordance with empirical evidence presented by the World Bank (2018; 2019a) for farms in Serbia and Croatia, Masterson (2007), Sini (2009), and consistent with the superior resource allocation control argument made by Mellor (1969).

123. **Large farms exhibit superior SE.** In fact, they are not far away (SE: 0.886) from the Minimum Efficient Size (MES) or in other words they are not underinvested (Tsekouras et al., 2008), while medium farms also perform well in terms of SE (Table 4). Subsidies provided to these two economic size classes facilitate liquidity which in turn, enable better scale decisions. In contrast, micro farms and to a lesser extent, small farms, suffer SE losses compared to larger farms, due to scale inefficiencies. They are underinvested and do not exploit returns to scale as efficiently as their larger peers. The MES of North Macedonia agriculture is quite high and hence, significant investments are needed by small and micro farms to converge to minimum cost conditions.

124. **Full agricultural training is linked to higher productive performance.** Farms with managers who have received full agricultural training are the best performers in terms of TE[43] (bcTE: 0.477). They are followed (Table 4) by farms run by farmers with only practical training and experience (bcTE: 0.460). In contrast, farms with managers who have received basic training suffer from TE losses (bcTE: 0.419). Considering that this group is the largest in the sample (51 percent of farms), this finding raises questions on the effectiveness of basic training schemes in the country, especially in view of the skill-demanding nature of green growth practices in agriculture. Different levels of agricultural training do not seem to affect SE performance.

125. **The age of farm managers does not seem to contribute to higher productive performance**. This finding holds for both TE and SE (Table 5) and generates reservations on the effectiveness of the young farmers' scheme.

[43] This finding should be treated with caution, as fully trained farm managers are only 8.1 percent of the 2018 FADN sample.

Table 4. Differences of bcTE and SE, by economic size and training, North Macedonia, 2018

			Technical Efficiency			Scale Efficiency		
Grouping Variable	Subgroup	No. of Farms (%)	Average TE of the subgroup (std.error)	t-statistic (p-value)	Comparing group TE with the TE of all farms	Average SE of the subgroup	t-statistic (p-value)	Comparing group SE with the SE of all farms
Size	Micro	130 (21.85)	0.499 (0.017)	3.953 (0.001)	Greater	0.535 (0.020)	-12.750 (0.000)	Smaller
	Small	163 (27.40)	0.441 (0.013)	0.089 (0.928)	Equal	0.735 (0.017)	-1.777[44] (0.076)	Smaller
	Medium	154 (25.88)	0.368 (0.012)	-6.341 (0.000)	Smaller	0.860 (0.014)	7.214 (0.000)	Greater
	Large	148 (24.87)	0.462 (0.015)	1.630 (0.104)	Equal	0.886 (0.011)	10.222 (0.000)	Greater
Training	Only practical	243 (40.84)	0.460 (0.012)	2.146 (0.032)	Greater	0.780 (0.014)	1.620 (0.105)	Equal
	Basic	304 (51.09)	0.419 (0.010)	-2.920 (0.003)	Smaller	0.747 (0.014)	-1.498 (0.134)	Equal
	Full	48 (8.07)	0.477 (0.021)	1.710 (0.092)	Greater	0.756 (0.030)	-0.165 (0.869)	Equal

Source: World Bank staff calculations.

Table 5. Differences of bcTE and SE, by farm manager's age, North Macedonia, 2018

				Technical Efficiency			Scale Efficiency		
	Grouping Variable	Subgroup	No. of young farmers (experienced)	Average TE of young (TE of experienced)	t-statistic (p-value)	Comparing group TE with the TE of all farms	Average SE of the subgroup	t-statistic (p-value)	Comparing group SE with the SE of all farms
Age	Young (Experienced)	99 (496)	0.443 (0.440)	-0.169 (0.865)		Equal	0.761 (0.761)	0.001 (0.998)	Equal

Source: World Bank staff calculations.

126. Output orientation does not seem to link to higher performance. TE differentials between farms of different output orientations do not seem to exist. From the three groups defined for this study, only specialist livestock farms seem to lag behind other farms in terms of TE (Table 6[45]). Farm types differ in their SE performance relative to their decisions with respect to scale. Specialist livestock farms (SE: 0.843), which are

[44] At the 10 percent significance level

[45] With the estimated TE value being significant at the 10 percent level.

more heavily subsidized, seem to have benefited from a performance premium oriented towards their scale decisions. The opposite holds for farms in the specialist crops group (SE: 0.743).

127. Regional differences in TE in North Macedonia are observed. In Stip (bcTE: 0.516) and Skopje (bcTE: 0.500) farms exhibit comparative advantages in terms of TE (Table 6), while the opposite is observed in the case of Bitola (bcTE: 0.359). Farms located in Kumanovo, Tetono, and Strumica do not exhibit TE differentials, that is, differences in bcTE between these farms and farms in other regions of North Macedonia are not statistically significant. In terms of SE, findings are rather mixed but in general, it seems that farms located in the analyzed regions and exhibiting comparative advantage on TE, also exhibit comparative disadvantage on SE, and vice-versa.

Table 6. Differences of bcTE and SE, by production orientation and regional location, North Macedonia, 2018

			Technical Efficiency			Scale Efficiency		
Grouping Variable	Subgroup	No. of Farms (%)	Average TE of the subgroup (std.error)	t-statistic (p-value)	Comparing group TE with the TE of all farms	Average SE of the subgroup	t-statistic (p-value)	Comparing group SE with the SE of all farms
Farm type	Specialist crops	384 (64.54)	0.446 (0.009)	0.986 (0.324)	Equal	0.743 (0.011)	-2.4802 (0.013)	Smaller
	Specialist livestock	107 (17.98)	0.412 (0.018)	-1.723[46] (0.086)	Smaller	0.843 (0.018)	4.675 (0.000)	Greater
	Mixed farms	104 (17.48)	0.448 (0.020)	0.452 (0.651)	Equal	0.743 (0.026)	-0.786 (0.433)	Equal
Region	Skopje	113 (18.99)	0.500 (0.015)	4.102 (0.000)	Greater	0.746 (0.020)	-0.843 (0.399)	Equal
	Bitola	158 (26.56)	0.359 (0.013)	-6.907 (0.000)	Smaller	0.799 (0.018)	2.411 (0.016)	Greater
	Kumanovo	70 (11.76)	0.413 (0.021)	-1.321 (0.189)	Equal	0.798 (0.028)	1.362 (0.176)	Equal
	Stip	100 (16.81)	0.516 (0.018)	4.425 (0.000)	Greater	0.699 (0.027)	-2.546 (0.012)	Smaller
	Tetovo	55 (9.24)	0.420 (0.025)	-0.832 (0.408)	Equal	0.689 (0.036)	-2.103 (0.039)	Smaller
	Strumica	99 (16.64)	0.456 (0.017)	1.016 (0.310)	Equal	0.796 (0.018)	1.965 (0.050)	Greater

Source: World Bank staff calculations.

[46] At the 10 percent significance level.

128. Farms characterized by low input-intensity perform better in terms of TE compared to other farms in the country. Farms adopting medium and high input-intensity practices do not exhibit TE differentials (Table 7). On the other hand, high-intensive farms seem to be outperforming their peers in terms of SE (0.829), while low-intensive ones seem to be lagging (SE: 0.698). This finding is reasonable, as in contrast to low-intensity farms, a direct payments system favoring larger farmers provides them with necessary cash flow, which in turn enables better scale decisions.

Table 7. Differences of bcTE and SE, by farm input intensity, North Macedonia, 2018

			Technical Efficiency			Scale Efficiency		
Grouping Variable	Subgroup	No. of Farms (%)	Average TE of the subgroup (std.error)	t-statistic (p-value)	Comparing group TE with the TE of all farms	Average SE of the subgroup	t-statistic (p-value)	Comparing group SE with the SE of all farms
Green Growth	High	198 (33.28)	0.427 (0.013)	-1.198 (0.231)	Equal	0.829 (0.014)	5.386 (0.000)	Greater
	Medium	199 (33.44)	0.429 (0.012)	-1.076 (0.282)	Equal	0.757 (0.016)	-0.348 (0.728)	Equal
	Low	198 (33.28)	0.465 (0.013)	2.260 (0.024)	Greater	0.698 (0.018)	-4.469 (0.000)	Smaller

Source: World Bank staff calculations.

129. When findings on both types of efficiency are combined, the importance of structural issues characterizing the sector in North Macedonia emerges. Micro and low-intensive farms seem to be under-utilized and record low SE scores. In other words, due to credit and other constraints these farms are not able to become scale-efficient and benefit from returns to scale. In this respect, they exploit all their competences and capabilities from a managerial point of view to survive and hence, they show high TE scores. A comparatively high TE is their only way to survive. When farms grow to a certain size (i.e., medium) and/or become more intensive, they seem to become disorganized. The constraints associated with management practices and structural difficulties (e.g., limited access to finance, technology, markets) hinder their transformation to more efficient units. Skill acquisition programs do not seem to facilitate an improvement in their performance, as managers with basic training lag in efficiency. The same argument holds for rural development support for investments, at least in the short run, as adjustment to a new production structure often comes at a cost of lower efficiency. More importantly, the country's rather generous farm support program seems to provide the necessary "ammunition" for improvements in scale decisions. However, it does not facilitate improvements in managerial and organizational competence and production decisions and perhaps even leads to resource misallocation.

Efficiency Drivers

130. Technical and scale efficiency drivers are explored using linear regression.[47] Drivers related to farm economic size, location, output orientation, farm managers' characteristics (age, training), and subsidy type are considered. To investigate the determinants of farms' productive performance associated with different production practices and assess what determines improvements in the production performance of farms which are closer to the "green growth" paradigm, models are separately run for both the whole FADN sample and low input-intensity farms. Further, as low-intensive farms almost exclusively specialize in crops,[48] models are re-run only for crop farms.

131. The analysis of efficiency drivers partly confirms the findings of the differential analysis and enriches them with a causal relationship. For the whole FADN sample,[49] total subsidies (Table 8) seem to exert a slight positive influence on TE (0.099), while rural development support on investments negatively affects TE (-0.213). However, findings on the impact of rural development support on investments are susceptible to both the very short run and (as already noted) the productivity paradox. Subsidy intensity (total subsidies per ha of UAA) exerts a positive impact (0.162) on TE; however, this is up to a threshold, as further growth in subsidy intensity seems to be negatively influencing TE (-0.014). Farm economic size increases have a negative influence on TE and a positive one on SE. An increase in size would likely lead to TE losses. However, when farm size exceeds a certain limit (that of medium farms), then its increase benefits TE. With specialist crop farms as the reference group, livestock farms seem to be having a comparative disadvantage in terms of TE and a comparative advantage in terms of SE. With practical experience as the reference group, basic training seems to be negatively affecting TE (-0.050). Moreover, with farms located in Skopje as the reference group, farms in Bitola, Kumanovo, and Strumica seem to be characterized by TE inferiority.

132. In the case of low input-intensive farms, findings show that the provision of subsidies to farms of larger economic size does not benefit productive performance. Subsidy intensity (total subsidies per ha of UAA) exerts a positive impact (0.360) on TE, but further growth in subsidy intensity does not seem to play a role (Table 9). However, when subsidy intensity is moderated by economic size, there are TE loses (-0.0003). An increase in economic size (regardless of subsidies) also leads to TE losses, followed by a positive influence on TE when farm size exceeds a certain limit. With specialist crop farms as the reference group, mixed farms seem to have a comparative advantage on TE. However, farm age seems to exert a negative influence on the TE of low input-intensity farms. Farm location and training level do not affect TE, while none of the drivers examined seems to have a causal effect on SE.

47 Tobit estimation was also employed and produced the same results. This was expected as the truncation of the left-hand variables, i.e., TE and SE scores, was not the case since the bootstrapped version of DEA was employed.

48 Only 5 out of 198 low input-intensity farms specialize in livestock.

49 The analysis of the whole FADN sample is necessary to be able to draw comparisons between all farms and low-intensity farms in North Macedonia.

133. **In the case of the whole sample excluding livestock farms, an increase in subsidy intensity seems to negatively affect TE performance.** Subsidy intensity (i.e., subsidies per ha) exerts a positive impact on TE (0.503), which is much higher than that for the FADN sample which includes livestock farms (Table 10). However, the negative effects of further increases in subsidy intensity seem quite strong (-0.219); this shows that over-subsidization leads to efficiency losses. Also, there seems to be no causal relationship between subsidies (as an absolute value) and TE. Farm economic size effects on TE and SE are similar to those of the whole FADN sample, and the same applies to basic training. With farms located in Skopje as the reference group, farms in Bitola and Kumanovo seem to be characterized by TE inferiority, while farms in Stip and Tetovo are characterized by SE inferiority, and farms in Strumica by SE superiority.

134. **The provision of high subsidies to low input-intensive farms (excluding those specialized in livestock) of a larger economic size negatively affects their productive performance.** Subsidy intensity (Table 11) exerts a slightly stronger influence on TE compared to the whole sample of low input-intensity farms (0.370 vs 0.360). However, in contrast to the whole sample of low-intensive farms, there are negative effects of an increase in subsidy intensity (-0.151), while a statistically significant negative effect (even though small) appears when subsidy intensity is moderated by farm economic size (-0.0003). This finding implies that subsidy intensity positively affects the TE of low-intensive farms; however, these positive effects turn into negative ones when both subsidies per ha and farm economic size exceed a certain threshold. In other words, in the case of low-intensive farms, heavier subsidization per ha coupled with larger economic size generates diminishing marginal TE returns of subsidies. In contrast, a smaller amount of subsidy per ha directed towards smaller (in terms of economic size) farms, seems able to benefit their productive performance.

135. **Finally, in all the explorations of the drivers, one should consider factors beyond traditional economic characteristics, which in the present study constitute the so-called unobserved heterogeneity.** More specifically, farmers' personal characteristics (experience, family status, etc.), participation in networks, local and regional social capital, extroversion of the farms, local and regional infrastructure, public goods, entrepreneurial spirit and attitude, and especially innovation conditions should be considered when approaching determinants of efficiency in North Macedonia agriculture.

Table 8. Drivers of TE and SE: Ordinary Least Squares regression results, North Macedonia, 2018 (All farms; N=595)

Drivers		TE	SE
Size	Size	-0.0270*** (0.00455)	0.0183** (0.00558)
	Size^2	0.000868*** (0.000216)	-0.000392* (0.000187)
Region	Skopje	0 (.)	0 (.)
	Bitola	-0.113*** (0.0242)	-0.0411 (0.0327)
	Kumanovo	-0.0931*** (0.0266)	0.0168 (0.0369)
	Stip	0.00739 (0.0243)	-0.0714* (0.0331)
	Tetovo	-0.0503 (0.0264)	-0.0951* (0.0410)
	Strumica	-0.0597** (0.0225)	0.0585* (0.0285)
Specialization	Specialist crops	0 (.)	0 (.)
	Specialist livestock	-0.0779*** (0.0233)	0.109*** (0.0288)
	Mixed farms	-0.0186 (0.0205)	0.0277 (0.0308)
Age	Experienced farmers	0 (.)	0 (.)
	Young farmers	0.0188 (0.0202)	-0.0275 (0.0254)
Training of the manager	Only practical experience	0 (.)	0 (.)
	Basic training	-0.0496*** (0.0147)	-0.00267 (0.0196)
	Full training	-0.0247 (0.0274)	0.00220 (0.0334)
Subsidies	Total subsidies (TS)	0.0996* (0.0428)	0.101 (0.0635)
	TS / UAA ha	0.162** (0.0542)	0.00493 (0.112)
	(TS / UAA ha)^2	-0.0140* (0.00696)	0.00276 (0.00927)
	Size*(TS / UAA ha)	0.0000593 (0.000183)	-0.0000387 (0.000275)
	Subsidies on investment	-0.213* (0.0970)	-0.150 (0.161)
	Subsidies on crops	-0.0134 (0.0837)	0.197 (0.103)
	Subsidies on livestock	0.0260 (0.0644)	-0.0687 (0.0781)
	Subsidies on industrial crops	-0.0720 (0.0387)	0.0942* (0.0446)

Drivers		TE	SE
	_cons	0.586*** (0.0221)	0.673*** (0.0298)
	N	595	595
	R^2	0.245	0.164
	adj. R^2	0.218	0.135

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: World Bank staff calculations.

Table 9. Drivers of TE and SE: Ordinary Least Squares regression results, North Macedonia, 2018 (Low input-intensity farms; N=198)

Drivers		TE	SE
Size	Size	-0.0357*** (0.00775)	-0.00892 (0.0112)
	$Size^2$	0.000870*** (0.000238)	0.000243 (0.000320)
Region	Skopje	0 (.)	0 (.)
	Bitola	-0.0704 (0.0443)	0.0697 (0.0638)
	Kumanovo	-0.0295 (0.0516)	0.0397 (0.0744)
	Stip	0.0630 (0.0416)	-0.117 (0.0599)
	Tetovo	0.0219 (0.0418)	-0.0968 (0.0692)
	Strumica	0.00195 (0.0453)	0.0810 (0.0610)
Specialization	Specialist crops	0 (.)	0 (.)
	Specialist livestock	0.0332 (0.0723)	0.123 (0.0936)
	Mixed farms	0.125* (0.0501)	-0.0168 (0.0704)
Age	Experienced farmers	0 (.)	0 (.)
	Young farmers	-0.0599* (0.0286)	-0.00714 (0.0538)
Training of the manager	Only practical experience	0 (.)	0 (.)
	Basic training	-0.0250 (0.0246)	0.0117 (0.0370)
	Full training	0.0499 (0.0482)	-0.0263 (0.0699)

Drivers		TE	SE
Subsidies	Total subsidies (TS)	0.164 (0.0940)	0.228 (0.220)
	TS / UAA ha	0.360* (0.170)	-0.357 (0.357)
	(TS / UAA ha)^2	-0.148 (0.0754)	0.185 (0.177)
	Size*(TS / UAA ha)	-0.000311* (0.000137)	0.000503 (0.000302)
	Subsidies on investment	0.202 (0.236)	0.00954 (0.361)
	Subsidies on crops	-0.0898 (0.110)	-0.00805 (0.188)
	Subsidies on livestock	-0.492 (0.249)	0.486 (0.493)
	Subsidies on industrial crops	-0.0305 (0.0508)	0.0173 (0.0654)
	_cons	0.512*** (0.0432)	0.688*** (0.0586)
	N	198	198
	R^2	0.365	0.210
	adj. R^2	0.293	0.121

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: World Bank staff calculations.

Table 10. Drivers of TE and SE: Ordinary Least Squares regression results, North Macedonia, 2018 (All farms except specialist livestock; N=488)

		(1) TE	(2) SE
Size	Size	-0.0281*** (0.00477)	0.0146* (0.00634)
	Size^2	0.000924*** (0.000221)	-0.000349 (0.000234)
Region	Skopje	0 (.)	0 (.)
	Bitola	-0.113*** (0.0272)	-0.0496 (0.0381)
	Kumanovo	-0.0692* (0.0292)	0.00193 (0.0439)
	Stip	0.0488 (0.0268)	-0.0907* (0.0390)
	Tetovo	-0.0284 (0.0288)	-0.110* (0.0501)
	Strumica	-0.0376 (0.0233)	0.0589 (0.0308)

		(1) TE	(2) SE
Specialization	Specialist crops	0 (.)	0 (.)
	Mixed farms	-0.0239 (0.0228)	0.0131 (0.0361)
Age	Experienced farmers	0 (.)	0 (.)
	Young farmers	0.00728 (0.0219)	-0.0249 (0.0288)
Training of the manager	Only practical experience	0 (.)	0 (.)
	Basic training	-0.0428** (0.0155)	-0.0123 (0.0223)
	Full training	-0.00773 (0.0283)	-0.000981 (0.0354)
Subsidies	Total subsidies (TS)	0.0521 (0.0700)	0.211 (0.121)
	TS / UAA ha	0.503*** (0.115)	-0.342 (0.239)
	(TS / UAA ha)^2	-0.219*** (0.0567)	0.182 (0.122)
	Size*(TS / UAA ha)	-0.000127 (0.000144)	0.000317 (0.000248)
	Subsidies on investment	-0.164 (0.104)	-0.182 (0.179)
	Subsidies on crops	-0.00683 (0.0929)	0.107 (0.122)
	Subsidies on livestock	-0.147 (0.275)	0.555 (0.359)
	Subsidies on industrial crops	-0.0553 (0.0424)	0.0801 (0.0504)
	_cons	0.562*** (0.0242)	0.696*** (0.0337)
	N	488	488
	R^2	0.289	0.170
	adj. R^2	0.260	0.137

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: World Bank staff calculations.

Table 11. Drivers of TE and SE: Ordinary Least Squares regression results, North Macedonia, 2018 (Low input-intensity farms except specialist livestock; N=193)

		TE	SE
Size	Size	-0.0355*** (0.00769)	-0.00910 (0.0108)
	$Size^2$	0.000862*** (0.000238)	0.000166 (0.000329)
Region	Skopje	0 (.)	0 (.)
	Bitola	-0.0717 (0.0457)	0.0869 (0.0625)
	Kumanovo	-0.0243 (0.0528)	0.0175 (0.0765)
	Stip	0.0602 (0.0423)	-0.121* (0.0605)
	Tetovo	0.0218 (0.0424)	-0.107 (0.0692)
	Strumica	0.00181 (0.0457)	0.0780 (0.0608)
Specialization	Type A (crops)	0 (.)	0 (.)
	Type C (mixed)	0.125* (0.0515)	-0.0881 (0.0722)
Age	Experienced farmers	0 (.)	0 (.)
	Young farmers	-0.0625* (0.0304)	0.0206 (0.0527)
Training of the manager	Only practical experience	0 (.)	0 (.)
	Basic training	-0.0232 (0.0249)	0.00568 (0.0371)
	Full training	0.0498 (0.0485)	-0.0124 (0.0679)

		TE	SE
Subsidies	Total subsidies (TS)	0.169 (0.0926)	0.256 (0.243)
	TS / UAA ha	0.370* (0.181)	-0.563 (0.356)
	(TS / UAA ha)^2	-0.151* (0.0758)	0.205 (0.174)
	Size*(TS / UAA ha)	-0.000315* (0.000154)	0.000744* (0.000288)
	Subsidies on investment	0.201 (0.238)	0.0232 (0.367)
	Subsidies on crops	-0.0957 (0.112)	-0.0432 (0.202)
	Subsidies on livestock	-0.515 (0.597)	2.315** (0.837)
	Subsidies on industrial crops	-0.0306 (0.0514)	0.00292 (0.0643)
	_cons	0.511*** (0.0437)	0.692*** (0.0591)
	N	193	193
	R^2	0.361	0.222
	adj. R^2	0.291	0.137

Note: Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Source: World Bank staff calculations.

OPTIONS WITHIN A GREENER POLICY STRATEGIC APPROACH

136. **Policy recommendations drawn from this analysis that aim to facilitate the green transition of agri-food in North Macedonia correspond to both the short and longer terms.** In the short term, the government should ensure that the new policy approach and specific measures, especially with regards to direct payments, are materialized.

137. **Knowledge transfer and advisory services should improve to facilitate efficiency gains associated with greener practices.** This is especially important for the use of fertilizers and pesticides, where a mix of effective advice and controls are necessary. The same holds for organic farming to ensure that the relevant legislation is applied properly.

138. **Changes to the support mix associated with EGD targets also seem necessary in the short run.** This includes an increase in support rates for organic farming and a convergence of these rates to EU-average levels. It also includes a restructuring of GHG emissions-reduction measures for agriculture and an emphasis on actions to reduce livestock emissions and especially those from enteric fermentation.

139. **In the longer term, to be effective, policy initiatives aiming to facilitate the green transition of agri-food should be integrated into a new strategic approach.** This analysis has confirmed that the green transition of North Macedonia's agri-food system has the potential to improve both its competitiveness and sustainability. However, the complexity and diversity of the country's agri-food system requires a careful consideration of its elements to ensure that the right incentives are facilitated by policy action.

140. **A review of the current agricultural policy mix indicates the need to repurpose agricultural support.** This shift should be towards productivity-enhancing innovations that generate fewer negative environmental impacts (Gautam et al., 2022). Also, a focus on the provision of public goods (advisory services, training, agricultural infrastructure) to facilitate economic and environmental sustainability in the sector is necessary. Green transition in agri-food can be promoted through policies to improve sector efficiency and promote sustainable practices. As shown by the findings of the econometric analysis, policy initiatives that aim to achieve efficiency gains could correspond to a "win-win" strategy for both environmental and economic performance for farmers. Policy goals should be clear and ambitious, but also realistic, and responding to needs and strategic objectives.

141. **Supply-side policy actions are essential.** Better targeting of farm support is essential as higher subsidies seem to lead to the increased dependence of farm incomes on transfers and to farm intensification, without necessarily improving economic performance. To some extent, farm support should relate to agricultural practices and systems. This implies payments that are proportional to both policy domains and the contributions of each domain to climatic, environmental, and economic benefits. A re-focusing of agri-food public support and an increase in the share of policy funds to the environment and climate action that is compatible with

EU practice is necessary. Further, support schemes should be stable and not sensitive to changes, so that they promote investments and facilitate a robust change in productive behaviour. Such support would also reduce the distributional inequity that characterizes current farm support approaches (World Bank, 2018b).

142. **Policy should create strong incentives that favor changes in production systems and promote the de-intensification of production.** A de-intensification process would likely lead to an increase in production costs, but this could diminish over the longer term thanks to productivity gains. In the short term, higher production costs may reduce farmers' incentives to switch to less-intensive practices (Dupraz and Guyomard, 2019). Hence, policy should compensate farmers for the higher production costs associated with more environmentally friendly agricultural practices. An improvement of farmers' skills through training and advisory actions to disseminate best agro-ecological practices is essential. Investment aids to favor the adoption of relevant technology and innovation should be reinforced.

143. **Gains in efficiency leading to the greener production transformation is the route to a more competitive and export-oriented agri-food sector in North Macedonia.** Efficiency gains induced by a repurposed agri-food policy mix would reduce the negative climatic and environmental impacts of agricultural practices and improve farms' economic performance in the longer term. For instance, the development of precision farming and expansion of broadband coverage may contribute to a reduction in pesticide and fertilizer use. In so doing, such innovations have the potential to reduce variable production costs. However, they require investments that increase fixed costs. Innovation adoption in North Macedonia's agriculture sector has been low. A lack of information and skills, constraints in public infrastructure and in credit supply, and uncertainty about the performance of new technology could explain the low rates of adoption. To encourage their uptake, in addition to better infrastructures, accompanying actions that include the dissemination of innovative practices and adapted agricultural advisory services are required. Public support in the form of targeted investment aids, should be used to facilitate the adoption of innovation which leads to more sustainable practices.

144. **An integrated policy approach is of major importance.** Producers' commitments to implement more demanding agricultural practices strongly depend on the results of environmental efforts. The adoption of environmentally sustainable production processes at the farm level, could lead to a more efficient use of farm inputs and even positive impacts on gross margins. However, the net impact on farmers' incomes will depend on labor skills and investments required to achieve such improvements. Production risks, investment needs, and human costs required to acquire new skills seem important in this transition and policy should integrate specific action to deal with these issues.

145. **Producers' decisions to redesign their production systems will also depend on the vertical relationships in food chains between producers, processors, and retailers.** These would affect price transmission and value sharing along food chains. Vertical agreements and long-term contracts in the framework of chain agreements between producers' organizations and food processors and retailers should be

facilitated to promote investments at the farm level. This challenge has been identified by the F2F Strategy (EC, 2020a) and requires attention from North Macedonia policy makers.

146. **A sustainable agri-food sector must ensure the sufficient, varied, and affordable supply of food. This has been a priority of modern food policy, which has been exacerbated by the COVID-19 pandemic and the war in Ukraine.** Public support should shield markets from higher production costs triggered by environmentally friendly farm practices. The de-intensification of agriculture would likely lead to an increase in production costs, which in the short term, could lead to food price increases and to consumers' welfare losses. Price increases (such as those currently experienced due to the Ukraine war and the COVID-19 crisis) could have very negative effects, especially on poor and disadvantaged households confronted with food insecurity challenges. Due to budgetary constraints, consumers could shift towards lower-price food products. This reaction could have negative ecological impacts if the environmental quality of lower-price food products is also lower. In other words, consumer response could directly affect producers' decisions as such a shift would reduce producers' incentives to adopt more environmentally friendly farming practices and lead them to reduce their costs by lowering the quality of both products and production processes. Hence, as noted above, environmentally friendly practices by producers should be compensated with support for environmental services. Such support should compensate producers for both extra costs and the supply of public goods and facilitate (to a certain extent) the transfer of the economic burden of internalizing the climatic and environmental impacts of agricultural practices and food systems, from the consumer to the taxpayer (EC, 2020a; EP, 2020).

147. **Institutional strengthening is important for the green transition of agri-food in North Macedonia.** The capacity of research and extension systems, as well as of the public administration, should be enhanced and should become climate-proof. Cooperation among scientific and educational bodies, extension and training services, and producers and processors should facilitate a transfer to innovative and environmentally friendly technology and farming methods, which will, at the same time, facilitate economic performance. The systematic monitoring and evaluation of environmental and economic results and impacts would improve policy efficacy and legitimacy.

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