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How does the Dairy Modernization and Market Access (DiMMA) programme in Georgia contribute to greenhouse gas emissions and food security?



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Published by

The Food and Agriculture Organization of the United Nations
and
International Fund for Agricultural Development

Rome, 2024

Required citation:

Özkan, Ş., Kvirikashvili, D., Sharabidze, K., Ndung'u, P. and Doro, E. 2024. *How does the Dairy Modernization and Market Access (DiMMA) programme in Georgia contribute to greenhouse gas emissions and food security?* Rome, FAO and IFAD.
<https://doi.org/10.4060/cd1672en>

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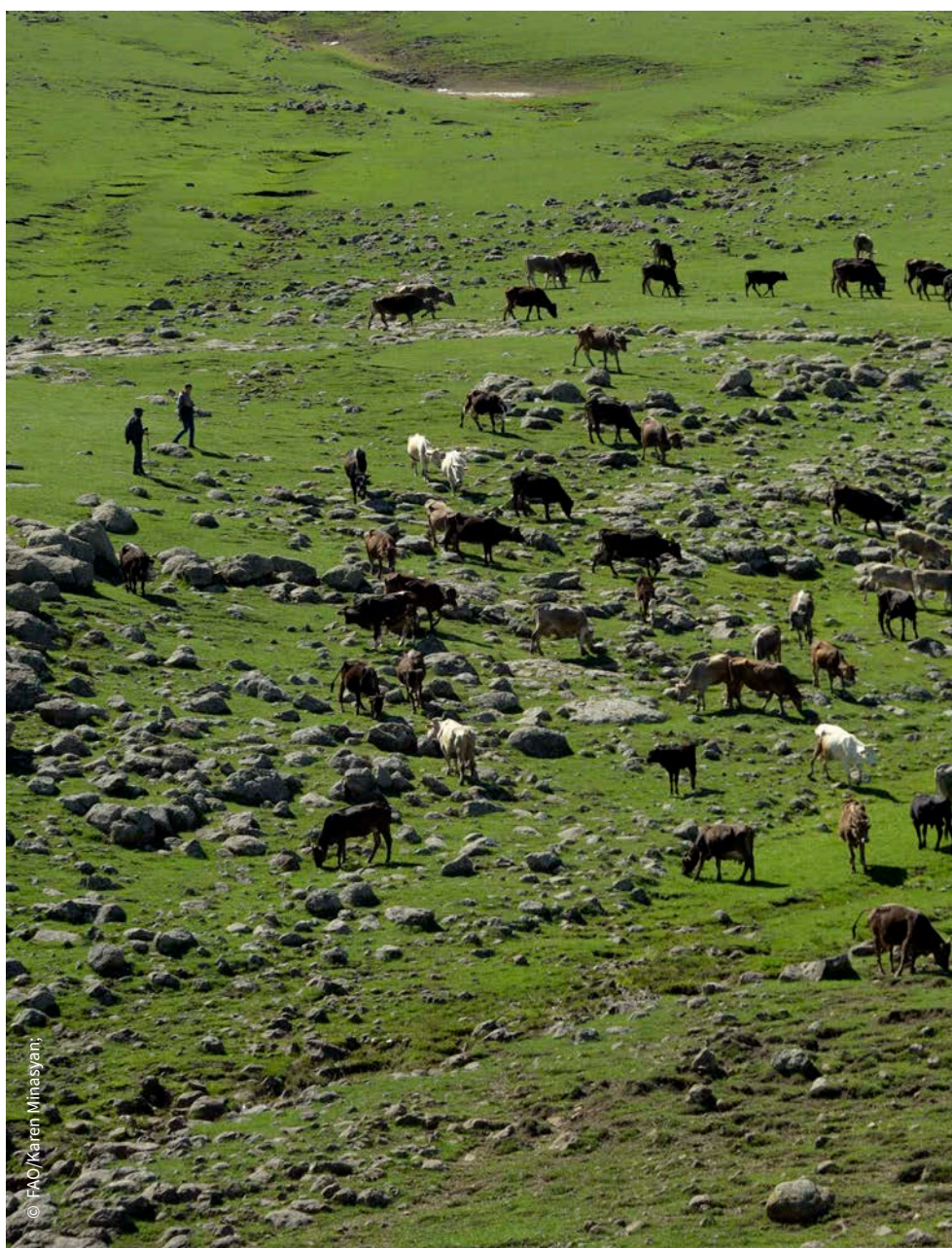
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Acknowledgements

This study received funding from the second phase of IFAD's Adaptation for Smallholder Agriculture Programme (ASAP2). The authors are grateful to all the workshop participants who contributed to the improvement and validation of the data in Tbilisi on 6 December 2023. The administrative support of Dominik Wisser and Hisham Zehni, as well as the earlier contributions and supervision of Anne Mottet to the overarching project "Low carbon and resilient livestock development strategies for climate informed investments" are greatly acknowledged.



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Background

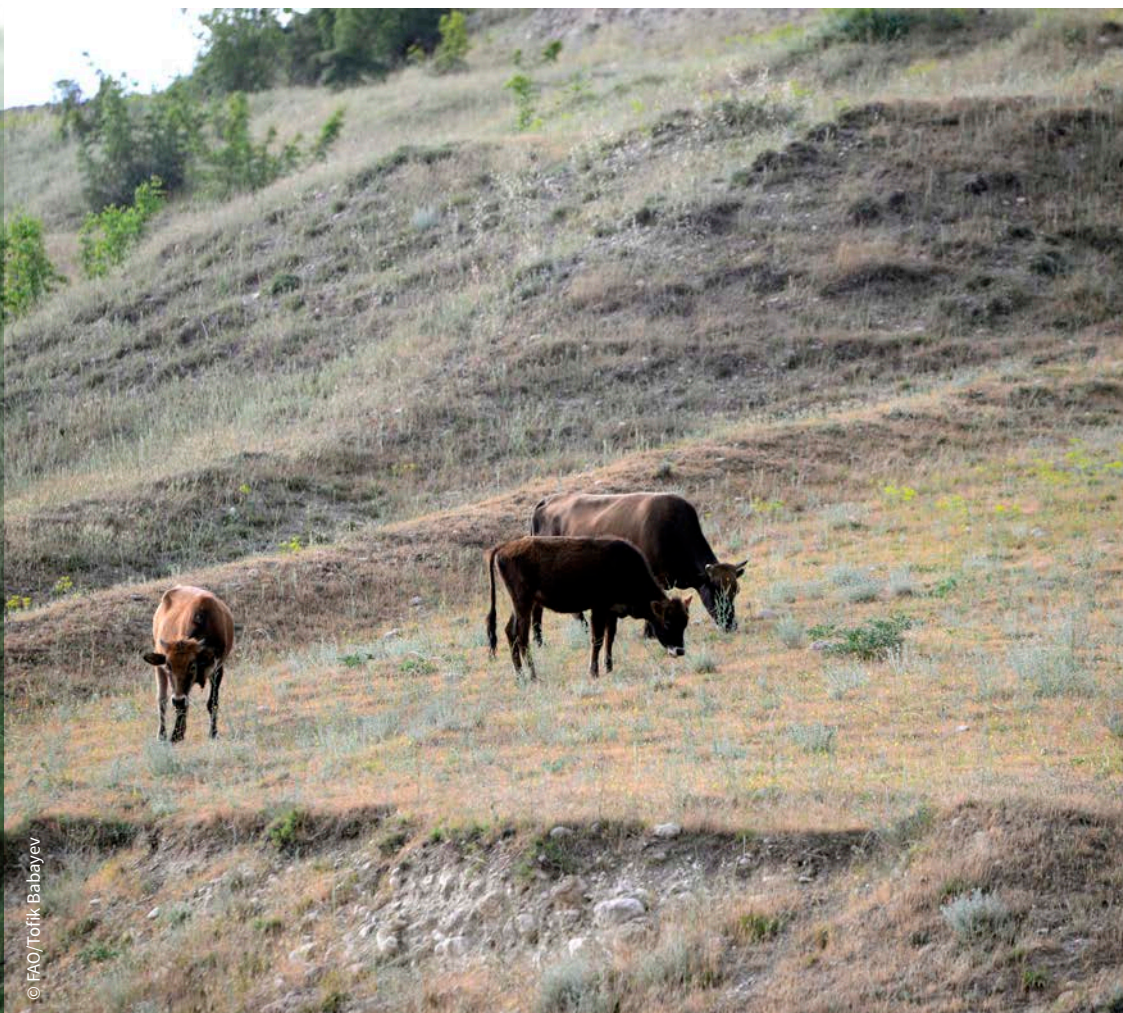
The Dairy Modernization and Market Access (DiMMA) Programme in Georgia aims to improve the productivity of smallholder dairy farming systems through better nutrition and feeding, veterinary care and animal health, and breed improvements. In addition, it aims to strengthen the resilience of farmers to cope with the adverse effects of climate change through improved pasture management practices, capacity development measures, and facilitating stakeholder engagement and policy dialogues. Funded by IFAD at USD18.2 million, the project receives national and international co-finance, with a total cost of USD53.43 million and is planned to run between 2018 and 2025 (IFAD, 2018). The Project's mid-term review in July 2023 (IFAD, 2023) highlighted that the project continues to progress based on the dairy cluster development approach (i.e., 18 clusters established in the six target regions to enable replication and transfer of lessons learned). The regions covered by the project are Kakheti, Kvemo Kartli, Imereti, Samegrelo and Zemo Svaneti, Samtskhe-Javakheti and Racha-Lechkhumi and Kvemo Svaneti.

This assessment was undertaken as part of the FAO-IFAD project “Low carbon and resilient livestock development strategies for climate informed investments” (FAO, 2024) aiming to support IFAD-funded projects in Brazil, Georgia, Kyrgyzstan (IFAD and FAO, 2021), Lesotho (Özkan, Doro and Mottet, 2023), Malawi, Rwanda, Tajikistan and Uzbekistan to develop and implement technical strategies that will improve livestock production while reducing greenhouse gas (GHG) emissions.



Objective and scenarios

The aim of this study is to report the impact of the DiMMA programme on GHG emissions for both total emissions and emissions intensity (i.e. emissions produced per unit of product), food security (reported in protein production) and resource use (reported in feed intake) for two scenarios: **without project (WOP)** representing the case without any improvements to herd, feed and manure parameters; and **with project (WP)** representing the situation with project improvements on herd structure, feeding and manure management over the project timeline. The scenarios by which the WP impact was evaluated cover a combination of interventions including: improved animal health via improved veterinary care; improved breeding via artificial insemination (AI); improved feeding and nutrition via pasture improvements, training and value chain improvements; and improved manure management via trainings and value chain improvements.



Global Livestock Environmental Assessment Model-*interactive* (GLEAM-*i*)

The assessment was conducted using FAO's Global Livestock Environmental Assessment Model-*interactive* (GLEAM-*i*) (<https://gleami.apps.fao.org/>), a life-cycle-based approach considering the GHG emissions from the production of inputs up to the farm gate. The three major GHGs covered in the tool are methane (CH₄), nitrous oxide (N₂O) and carbon dioxide (CO₂). The global warming potential used to convert CH₄ and N₂O to CO₂ equivalents (CO₂e) are 27 and 273, respectively (IPCC, 2021). The estimations of GHG emissions in GLEAM-*i* are based on the Intergovernmental Panel on Climate Change (IPCC)'s Tier 2 methodology. While most countries, including Georgia use the Tier 1 approach in reporting national GHG emissions, the value of this approach is limited for policy decisions because it assumes that livestock of different ages and breeds have the same emissions per head and that these emissions do not change over time or by management practices. In contrast, the Tier 2 approach can better account for livestock species, management practices and animal performances, and it is therefore essential to use the Tier 2 approach to capture the impact of livestock development and mitigation interventions on GHG emissions (Wilkes and van Dijk, 2018).

The GLEAM-*i* tool helps to generate baseline and improved scenarios of herd management (including reproduction and health), feeding and manure management systems. The main results presented are: total emissions (t CO₂e/year), emission intensity (kg CO₂e/kg protein), protein production (t protein/year), and feed consumption (t dry matter (DM)/year). The sources of GHGs covered in GLEAM-*i* are CH₄ from enteric fermentation, CH₄ and N₂O from manure management, N₂O from synthetic fertilizer application and crop residue decomposition, CO₂ emissions from feed production and processing, and CO₂ from on-farm energy use or infrastructure development (explained more in detail in IFAD and FAO, 2021).



Data and assumptions

The data required for GLEAM-*i* were collected through individual consultations and a multistakeholder event that took place in Tbilisi on 6 December 2023.

Assumptions in WP scenario: The following assumptions reflect a moderate improvement in most of the parameters of all three modules, even though the actual impact is unknown or cannot be calculated with certainty. *In the herd module:* age at first calving (-10 percent); death rate of adult and young animals (-10 percent); fertility rate (+4 percent); live weight at all life stages (+5 percent); milk yield (+20 percent); replacement rate (-10%) – reflecting improvements in animal health, reproduction and productivity via improved breeding, veterinary care and feeding. *In the feed module:* Increased the share of crop residues from maize from 10 percent to 12 percent; removed crop residues from other grains; added fodder beet (7 percent); added fresh mixture of grass and legumes (10 percent); increased grains from 2 percent to 6 percent; reduced hay or silage from alfalfa from 12 percent to 9 percent; and finally reduced hay or silage from grass and legumes from 21 percent to 11 percent – reflecting improvements in pasture management and farmers’ knowledge of feeding. *In the manure module:* A 5 percent shift from pasture/range/paddock to solid storage – reflecting improvements in good practices as a result of the trainings.

Table 1. Herd, feed and manure data used in the assessment

	Parameters	Unit	Description	WOP	WP
HERD	Age at first parturition	months	Average age at which adult females have their first parturition	27	24.3
	Death rate of adult animals	%	Annual average percentage of non-intended deaths of animals after reaching maturity	5	4.5
	Death rate of young animals	%	Annual average percentage of non-intended deaths of animals before reaching maturity	7	6.3
	Fertility rate of adult females	%	Average percentage of successful adult female parturitions, including young animals that die before reaching maturity	77	80.1
	Live weight of adult females	Kg	Average live weight of adult females once they reach maturity	300	315
	Live weight of adult males	Kg	Average live weight of adult males once they reach maturity	350	368
	Live weight of meat females at slaughter	Kg	Average live weight at slaughter of adult females culled for meat	280	294
	Live weight of meat males at slaughter	Kg	Average live weight at slaughter of adult males culled for meat	330	347
	Milk fat	%	Average milk total fat content	3.6	3.6
	Milk protein	%	Average milk total protein content	3.3	3.3
	Milk yield	kg/year	Annual average milk yield per milking cow	1 400	1 680
	Number of adult females	Head	Number of adult reproductive females in the project	18 708	18 708
	Number of adult males	Head	Number of adult reproductive males in the project	935	935
	Replacement rate of adult females	%	Annual average rate of reproductive adult female replacement	14	12.6
	Weight at birth	Kg	Average live weight of offspring at birth	20	21

Source: Authors’ own elaboration.

	Parameters	Unit	Description	WOP	WP
FEED	Crop residues from maize	%	Fibrous residual plant material such as straw, brans, leaves, etc. from maize cultivation	10	12
	Crop residues from other grains	%	Fibrous residual plant material from barley, rye or oat cultivation	10	0
	Fodder beet	%	Fodder beet, also known as mangel beet or field beet	0	7
	Fresh grass	%	Any type of natural or cultivated fresh grass grazed or fed to the animals	45	45
	Fresh mixture of grass and legumes	%	Fresh mixture of any type of grass and leguminous plants fed to the animals	0	10
	Grains	%	Grains from barley, oat, buckwheat and fonio plants	2	6
	Hay or silage from alfalfa	%	Hay or silage from alfalfa	12	9
	Hay or silage from grass and legumes	%	Hay or silage produced from a mixture of any type of grass and leguminous plants	21	11
MANURE	Burned for fuel	%	The dung and urine are excreted in the field and sun-dried	5	5
	Dry lot	%	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically	5	5
	Pasture/Range/Paddock	%	The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed	50	45
	Solid storage	%	The storage of manure, typically for a period of several months, in unconfined piles or stacks	40	45

Source: Authors' own elaboration.

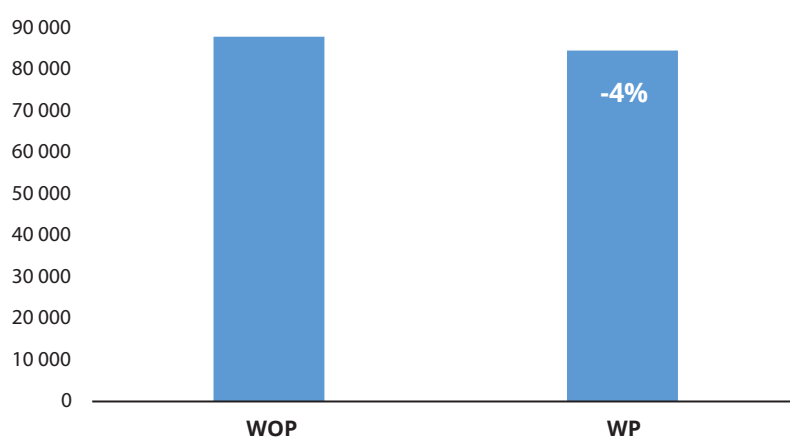


Results and discussion

The total GHG emissions in scenario WP decreased from 87 800 t CO₂e to 84 400 t CO₂e/year, a 4 percent reduction (Figure 1). This is just under 0.5 percent of the country's total emissions of 17.8 million tonnes of CO₂e in 2017 (EU4Climate, 2023). The reduction in total emissions is due partly to the reduced herd size in the WP scenario, which is achieved by reducing the age at first calving. Even though the project does not necessarily foresee a reduction in herd size (on the contrary, an additional 5 000 calves are expected to be born as a result of AI), the model simulates the biophysical processes to constitute a herd structure that is influenced by various parameters, including age at first calving, mortality rates, fertility rates, etc. Here, a lower age at first parturition results in fewer replacements and meat animals, leading to a shrinkage in herd size.

The improved digestibility of the ration led to a reduction in both CH₄ from enteric fermentation (from 2 477 000 to 2 343 000) and CH₄ from manure management (from 70 700 kg CH₄ to 67 800 kg CH₄/year), while N₂O emissions from manure management increased from 14 100 kg N₂O to 14 700 kg N₂O/year, reflecting the higher nitrogen content of the diet, especially from legumes (with 28 kg N/kg DM), but also from grains and fodder beet, compared to the crop residues of other grains with nitrogen content of 6.7 kg N/kg DM. Slightly higher N₂O emissions from manure may also be associated with the increased share of solid storage, considering that solid systems can lead to higher N₂O emissions. However, this increase was offset by the reduction in CH₄ from enteric fermentation and manure management, leading to a reduction in total net emissions. This example emphasizes the importance of taking a systems perspective, where all significant GHGs are assessed for their impact, instead of a single gas.

Figure 1. Total emissions (t CO₂e/year) of the DiMMA programme

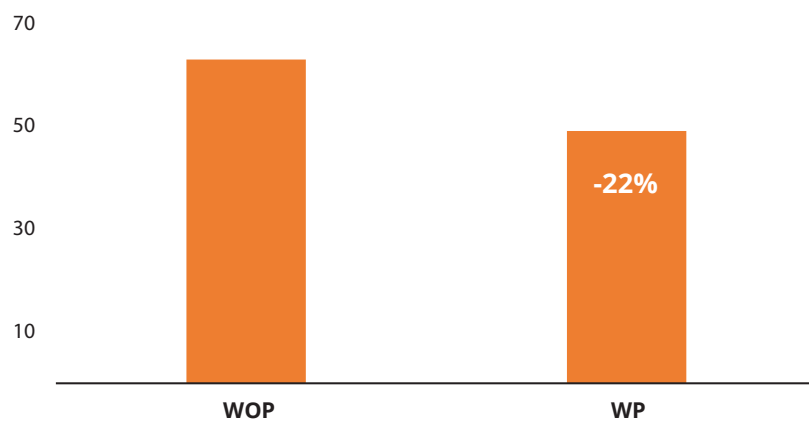


Source: Authors' own elaboration.

Of the total emissions, 75 percent are attributed to CH₄ from enteric fermentation, 16 percent to CO₂ and N₂O from feed, 5 percent to N₂O from manure management, 2 percent to CH₄ from manure management and a further 2 percent to CO₂ from energy use. Given the significant share of CH₄ emissions from enteric fermentation, it is important to focus on improving the digestibility and nutrient composition of the ration.

The emissions intensities for milk and meat are both reduced by 22 percent and 10 percent, respectively, reflecting the improved productivity in the WP scenario (Figure 2). The emissions intensity for milk of 49 kg CO₂e/kg protein is close to the average emissions intensity of 56 kg CO₂e/kg protein from grassland-based cattle production systems globally (FAO, 2023). Comparisons from Georgia or neighboring countries were not possible due to the lack of studies using Tier 2 methodology. However, large variations exist (e.g., from 25 kg to 230 kg CO₂ e/kg protein in Kyrgyzstan in Lopes *et al.* 2021) reflecting the level of productivity, feeding and management practices of each system.

Figure 2. Emissions intensity for milk (kg CO₂e/kg protein) of the DiMMA programme

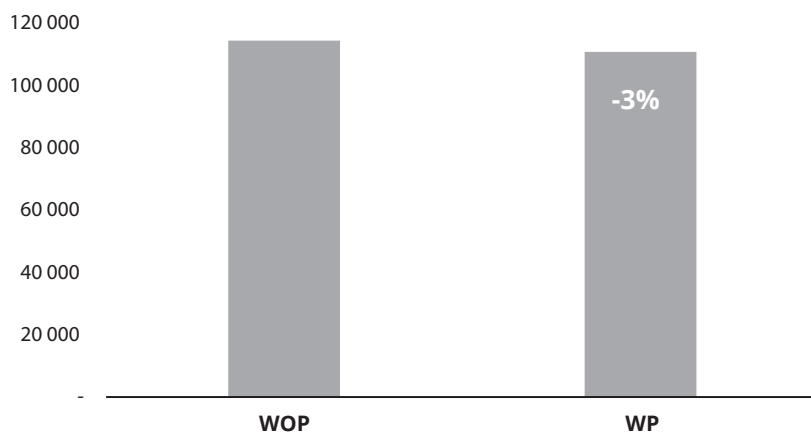


Source: Authors' own elaboration.



Feed intake was reduced by about 3 percent, possibly reflecting the reduced herd size of about 2,000 animals in the WP scenario, in addition to the increased digestibility of the diet. The inclusion of fodder beet and the replacement of crop residues from other grains with those from a fresh mixture of grass and legumes offer opportunities to reduce GHG emissions from the DiMMA programme (Figure 3).

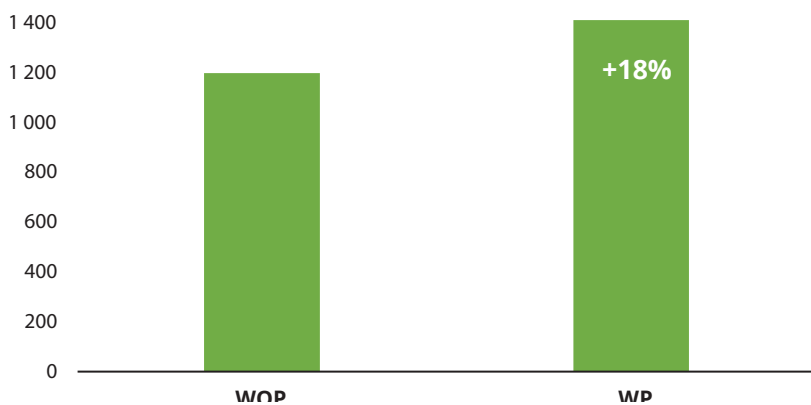
Figure 3. Feed intake (t DM/year) in the DiMMA programme



Source: Authors' own elaboration.

Finally, the project has the potential to increase protein production by 18 percent, mainly through increases in milk yield and animal live weight, contributing to food security (Figure 4).

Figure 4. Total protein production (t protein/year) from the DiMMA programme



Source: Authors' own elaboration.

It is important to note that the results reflect the assumptions described in the previous section, and whether the impact reported here will be achieved depends on the expected improvements in the parameters considered. This approach can be improved by integrating the relevant data parameters for both the WOP and WP scenarios in the mid-term review and during consultations with the project management unit in a way that the relevant data are collected and reported as part of the project deliverables.

Conclusions and reflections for a wider policy application

Grazing land management, manure management, feed and breeding optimization, and finally livestock health monitoring and disease prevention will remain promising mitigation strategies relevant to Georgian livestock production systems (Day, Lopez Legarreta and Schiefer, 2022). In this regard, Georgia's Long-Term Low Emission Development Strategy 2050, adopted in April 2023, provides a roadmap for the sustainable development of the livestock sector in Georgia.

The increased productivity may, however, lead to increased emissions if the herd sizes remain stable or even grow. It is not unrealistic to assume that the livestock sector in Georgia will grow in the near future, as increased production from dairy and meat-producing livestock has been identified as one of the priority areas for 2050 (Government of Georgia, 2023). The potential growth of the livestock sector calls for joint actions and policy decisions that take into account the variability between and within different livestock production systems. It also calls for enhanced capacities at institutional level to move to a Tier 2 approach to better account for the impact of livestock management practices and the varying nature of emissions over time and space.

Georgia is committed to reduce its national emissions by 50-57 percent and 35 percent, with and without international support, respectively, compared to 1990 levels (Government of Georgia, 2021). Agriculture with its 18.5 percent share of the total emissions will remain one of the most important sectors to target emission reduction nationally. It is also one of the most vulnerable sectors to the adverse effects of climate change, e.g., increased frequency and severity of droughts, floods and landslides (EU4Climate, 2023), highlighting the importance of adaptation planning alongside mitigation.



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