Food and Agriculture Organization of the United Nations

IFAD Investing in rural people

Technical note

Low carbon livestock development in Kyrgyzstan:

Quantifying the future impact of the Regional Resilient Pastoral Communities Project on greenhouse gas emissions

Low carbon livestock development in Kyrgyzstan

Quantifying the future impact of the Regional Resilient Pastoral Communities Project on greenhouse gas emissions

Authors. Şeyda Özkan[1], Anne Mottet[1] and Oliver Mundy[2]

[1] Food and Agriculture Organization of the United Nations (FAO)
[2] International Fund for Agricultural Development (IFAD)

Acknowledgements. The authors greatly appreciate the time and efforts of those who provided expert opinions during data collection: Shimels Wassie from UNIQUE, David Ward, Zholdoshbek Dadybaev and Almaz Dungalov and other technical experts from ARIS implementing the IFAD-funded Livestock Market Development Projects. Aliya Ibraimova and Salamat Dzhumabaeva from CAMP Alatoo Public Foundation also supported the data collection. We thank Maya Eralieva from German Agency for International Cooperation (GIZ), Gulbahar Abdurasulova and Andreas Wilkes from UNIQUE for their guidance to align this assessment to the livestock and pasture sector analysis for the update of Kyrgyzstan's Nationally Determined Contributions. We also thank Samir Bejaoui, Sebastian Subsol and Erica Doro from IFAD for their support. Rebecca Ferreira from IFAD and Claudia Ciarlantini from FAO supported the publication process of the report. This work was funded by the second phase of IFAD's Adaptation for Smallholder Agriculture Programme (ASAP2).

Recommended citation. IFAD and FAO (2021). Low carbon livestock development in Kyrgyzstan. Quantifying the future impact of the Regional Resilient Pastoral Communities Project on greenhouse gas emissions. Rome.

Layout. Rebecca Ferreira and Oliver Mundy | **Cover images**: Vyacheslav Oseledko (front) and Sergey Kozmin (back) from FAO | **July 2021**

About this report

This report presents the potential impact of the planned IFAD-funded Regional Resilient Pastoral Communities Project (RRPCP) (Box 1) on greenhouse gas (GHG) emissions, both in terms of the overall impact of the project, and as a possible input to the update of Kyrgyzstan's Nationally Determined Contributions (NDC). Previous NDCs have not formulated commitments to reduce emissions from the livestock sector, despite 85% of the agricultural area being used as pastures for grazing and 62% of the agricultural emissions coming from the livestock sector (Government of Kyrgyzstan 2016). Since the level of assessment in the NDC includes only direct emissions, this report also presents the overall impact of the RRPCP considering the life cycle emissions. It includes recommendations to mitigate the GHG emissions associated with cattle, sheep and goat production systems in Kyrgyzstan. The assessment was carried out using the Global Livestock Environmental Assessment Model-*interactive* (GLEAM-*i*), a tool developed by FAO to measure emissions from livestock value chains and compare the impact of future scenarios.

This assessment was undertaken as part of the FAO project "Low carbon and resilient livestock development strategies for climate informed investments" (read more). The project aims to support IFAD-funded projects in Ethiopia, Kenya, Kyrgyzstan, Lesotho and Tajikistan to develop and implement strategies that will improve livestock production while reducing the GHG emissions.

The main results presented in this report were published in an expert blog (read more). Results related to NDC have been included in the 2021 report "Analysis of livestock and pasture sub-sectors for the NDC revision in Kyrgyzstan" by GIZ, FAO and IFAD.

BOX 1. Regional Resilient Pastoral Communities Project (RRPCP)

The planned IFAD-funded project RRPCP was designed in 2019 and is expected to run between 2022 and 2026 covering all of Kyrgyzstan. The project aims to reduce poverty in rural areas through improving pasture productivity and enhancing climate resilience of pastoral communities. The project foresees a financial volume of USD 31.3 million. An additional USD 9.2 million is expected to be co-financed from the Adaptation Fund. The project has a strong focus on climate change adaptation of pastoral livestock systems. The project has USD 9.09 million attributed as adaptation finance and USD 2.47 million as mitigation finance (IFAD, 2019). The RRPCP is the continuation of Livestock and Market Development Projects I and II.

More information: https://www.ifad.org/en/web/operations/-/project/2000001978

Objectives

This study has the following objectives:

- Estimate the GHG emissions associated with dairy cattle, sheep and goat production systems in Kyrgyzstan
    - The emissions that would be expected under the planned IFAD-funded RRPCP based on the improvements targeted in the project (including life cycle emissions)
    - The emissions that would be expected to occur if the project is not implemented;
- Inform climate commitments by adapting the results of the RRPCP (i.e., reporting only direct emissions) as input to the NDC update, as RRPCP will be the largest donor-financed project supporting the country's livestock sector to adapt to climate change;
- Provide recommendations for livestock investments to improve production efficiency while reducing absolute emissions or emissions intensity.

Approach

This section outlines the methods adapted to assess the impact of RRPCP on GHG emissions.

Modelling and GLEAM-*i*

GLEAM-*i* (Box 2) was used for the assessment. RRPCP will target household dairy cattle, sheep and goat production systems in the country. Since the majority of cattle graze in Kyrgyzstan in summer, the production system selected in GLEAM-*i* was grassland-based dairy. For small ruminants, the selected production systems were grassland-based sheep and goats raised for meat. The input parameters and the assumptions for specific scenarios were inserted on the online version of GLEAM-*i*. Three gases are considered in GLEAM-*i*: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GLEAM-*i* uses life cycle approach to calculate the emissions associated with livestock production systems from production of inputs up to the farm gate (Table 1).

BOX 2. The Global Livestock Environmental Assessment Model-*Interactive* (GLEAM-*i*)

The model simulates biophysical processes and activities along livestock supply chains using a life cycle assessment approach. It estimates GHG emissions with the Intergovernmental Panel on Climate Change (IPCC) more advanced Tier 2 methodology. The 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 CO_2e/year), emissions intensity (t CO_2e/t protein), protein production (t protein/year), and feed consumption (t dry matter (DM)/year).

More information: https://gleami.apps.fao.org/

While the overall project evaluation included all the emissions sources outlined in Table 1, the results provided as input to the NDC update include only the direct emissions (i.e. enteric CH_4, and CH_4 and N_2O from manure management systems) in order to be compliant to the inventory methodologies. Similarly, there was a difference in the global warming potentials (GWP) used to convert CH_4 and N_2O to CO_2 equivalents (CO_2e) between the overall assessment and the input for NDC update. The overall assessment used the most recent GWP (Myhre et al., 2014) i.e., 34 for

CH_4 and 298 for N_2O while the input to NDC used 21 for CH_4 and 310 for N_2O (IPCC, 1996) because these were the GWPs used when the first NDC was submitted to UNFCCC in 2015 (The Kyrgyz Republic, 2015).

Data collection

Three virtual workshops were organized on 10, 12 and 23 March 2021 to introduce the tool GLEAM-*i* to the relevant stakeholders and to validate the default data. A number of follow up exchanges were organized with experts to discuss different opinions, to clarify and validate the data and assumptions. National statistics were consulted to obtain the animal numbers. The full list of data and assumptions are provided in Annex 1, and a calculation of animal numbers is presented in Annex 2.

TABLE 1. Source of emissions covered in GLEAM-*i*

Sources of emissions	Description	
Feed production and processing (CO_2)	Field operations	CO_2 emissions arising from the use of fossil fuels during field operations
	Fertilizer production	CO_2 emissions from the manufacture and transport of synthetic nitrogenous, phosphate and potash fertilizers
	Pesticide production	CO_2 emissions from the manufacture, transport and application of pesticides
	Processing and transport	CO_2 generated during the processing of crops for feed and the transport by land and/or sea
	Blending and pelleting	CO_2 arising from the blending of concentrate feed
Land use change (LUC) to expand feed production (CO_2)	Soybean cultivation	CO_2 emission due to LUC associated with the expansion of soybean
	Palm kernel cake	CO_2 emission due to LUC associated with the expansion of palm oil plantations
	Pasture expansion	CO_2 emission due to LUC associated with the expansion of pastures
Manure, fertilizer and crop residues for feed (N_2O)	Applied and deposited Manure	Direct and indirect N_2O emissions from manure - deposited on the fields and used as organic fertilizer
	Fertilizer and crop residues	Direct and indirect N_2O emissions from applied synthetic nitrogenous fertilizer and crop residues decomposition
Rice as feed (CH_4)	Rice production	CH_4 emissions arising from the cultivation of rice used as feed
Enteric fermentation (CH_4)*		CH_4 emissions caused by enteric fermentation
Manure management (CH_4)*		CH_4 emissions caused by manure management
Manure management (N_2O)*		N_2O emissions arising from manure storage and management
Direct energy use of production facilities (CO_2)		CO_2 emissions arising from energy use on-farm for ventilation, heating, etc.
Infrastructure development (CO_2)		CO_2 emissions arising from energy use during the construction of farm buildings and equipment

CH_4: methane, N_2O: nitrous oxide, CO_2: carbon dioxide

** Direct emissions used in NDC report*

Scenarios

Three scenarios were developed.

Baseline. This scenario represents 2022, the year that the RRPCP is expected to start.

With Project (WP). This scenario represents the situation with improvements made via the project to herd structure, feeding and manure management. The projection dates are 2025 and 2030 for the NDC update, and 2042 for the overall assessment of RRPCP (because the capitalization phase of the project is 20 years). The number of adult female and male animals are the same as in the baseline scenario (except where indicated for cattle), assuming that the project will succeed in limiting the growth of livestock numbers. However, since the numbers of adult females and males determine the herd structure, the number of total animals in the herd in the WP scenario varies (Table 2).

WithOut Project (WOP). This is the business-as-usual scenario, without any improvements to herd, feed and manure. The projection dates are 2025 and 2030 for the NDC update, and 2042 for the overall project assessment. The numbers of livestock are expected to increase in the WOP scenario (unlike in the WP scenario), based on the projected gross domestic product of the agricultural sector. The projected numbers were used to calculate the number of adult female animals in each year.

Comparing the WP and WOP scenarios reveals the expected impact of the project on GHG emissions. For the NDC update, the expected emissions are reported as the change at years 2025 and 2030, and not the cumulative change since the baseline year, as this is the approach used in inventory compilation. The cumulative net changes were calculated by subtracting the annual WP values for each species from those for WOP and multiplying the result by 10 to account for the change between WP and WOP, and then adding up the figures for the three species.

Assumptions

A number of assumptions were made for the scenarios.

Animal numbers. Annex 2 presents the estimates of animal numbers used in this assessment. These figures may have to be adjusted depending on the effectiveness of RRPCP in reaching the target number of households and curbing the growth in livestock numbers. The number of adult females was calculated by cross-checking the total number of animals in the GLEAM-*i* raw data. Here the number of females was increased or decreased until the point where the total number of animals in the herd in raw results matched the projected figures (the last three digits were ignored). The number of animals covered by the project is therefore the animal numbers obtained from the raw results (Table 2). For the overall project assessment in 2042, baseline figures in 2022 were increased by 20% to better reflect the sources of efficiency gains in scenario WP. The number of adult males was calculated based in 1:25 male to female ratio for all species (except where indicated for cattle).

TABLE 2. Number of animals calculated by GLEAM-i based on the total number of animals *

Species	Baseline	WP	WOP		
	2022		2025	2030	2042 (20% increase)
Cattle	660,000	610,000	730,000	848,000	792,000
Sheep	3,974,000	4,143,000	4,437,000	5,211,000	4,768,000
Goats	993,000	1,026,000	1,110,000	1,303,000	1,192,000

WP: with RRPCP project, WOP: without project

** Rounded*

Productivity. The project design document (IFAD, 2019) has set two specific development objectives: a 20% increase in milk yields and a 20% increase in productivity per animal. Therefore, live weights of cattle were assumed to increase by 20% during the project period due mainly to the introduction of a breeding programme. For sheep and goats, no breeding programme was planned in the project, so the live weights of sheep and goats were assumed not to change. However, for sheep and goats, the overall productivity increase of 20% was assumed come from an increase in the number of twin births (1.5 and 1.4 offspring per parturition for sheep and goats, respectively). The rate of twin births is expected to increase due to selective natural breeding, improved feeding and animal health. The vaccination programme and the concomitant improvements in animal health services are expected to reduce the mortality rates of animals by 20% (Demir et al., 2017). The improvements in age at first parturition in all three species and the slight increase in fertility rate of dairy cattle were attributed to improved reproduction, health and feeding. A reduction of 20% in replacement rates was attributed to improved herd structure where fewer replacement males and females would be needed.

Feed. The feeding of all species consisted of crop residues from other grains and wheat, hay or silage from alfalfa, grass and legumes as well as some silage (cattle) from grain plants. The majority of the ration for all species consisted of fresh grass through grazing. The improved feeding included (Annex 1 Table A1.2):

- Crop residues from sugar beet and maize instead of crop residues from other grains. The sugar beet was added to make up 5% of the diets of all animals. Beet is not purposefully grown for feed, but is cultivated to supply the two sugar factories in Kyrgyzstan, which produce a lot of residue beet in the form of *Jom*. Although *Jom* is high in energy, it also contains a lot of potassium, so can only be fed only in limited amounts.
- Fewer crop residues from wheat fed to cattle, and none to sheep and goats.
- A slightly lower quantity of hay or silage from alfalfa fed to cattle.
- Reduced amounts of hay or silage from grass and legumes fed to all species.
- Some grains and molasses fed to cattle.
- An increase in the amount of silage from maize plants.
- A lower amount of fresh grass in line with the pasture improvement strategy and the expected increase in higher quality fodder crops.

Manure. Manure management was not specifically targeted in the project. However, the assessment also included a suggestion to increase the share of manure managed under solid storage while reducing the share of manure deposited on pastures (cattle only). This suggestion made an additional reduction in absolute emissions.

Results

The results reported here show two different assessments: one for the overall impact of the RRPCP by 2042, and one as input to the NDC update using 2025 and 2030 as the years when the project impact would be achieved. The results should be interpreted in line with the approach taken in both assessments. In particular, the animal numbers used should be treated with caution since the projected animal numbers may be overestimates given the current intention to reduce growth rates of livestock populations in the country.

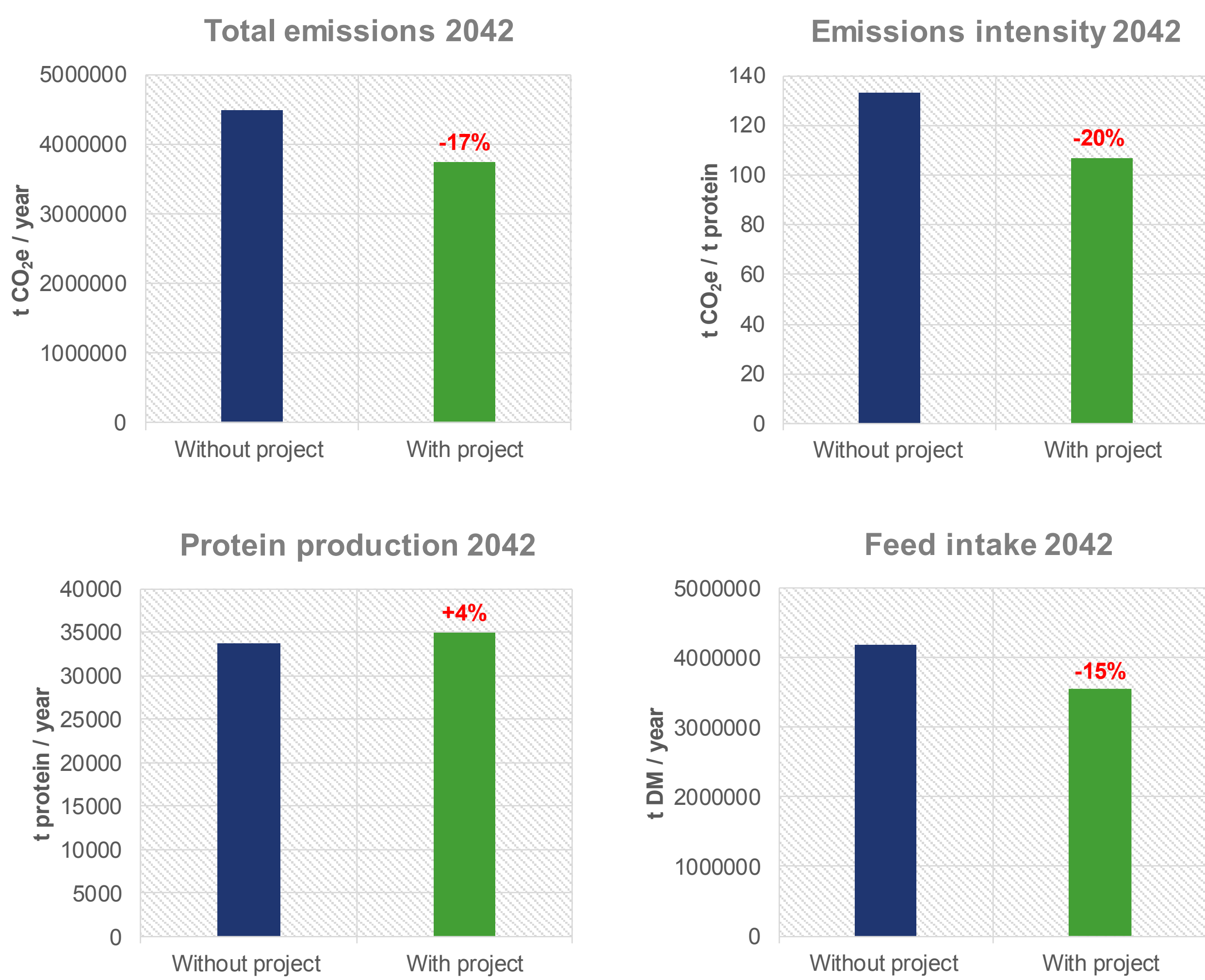
Overall assessment of RRPCP comparing 2022 and 2042

The model estimated that the project would reduce emissions from cattle, sheep and goats to

3,741,653 t in 2042, compared to 4,485,874 t CO_2e/year without the project (a reduction of 17%). The emissions intensity with the project was estimated at 107 t in 2042, compared to 133 t CO_2e/t protein with no project (a reduction of 20%). The total annual protein production with the project (35,001 t) is predicted to be 4% higher than if no project took place (33,705 t). This gain would be achieved with fewer animals, but whose live weights and milk yield (for cattle) were improved by 20% over the project period. The feed intake, on the other hand, was predicted to be 3,545,484 t with the project, compared to 4,180,317 t dry matter/year without (a 15% reduction), as a result of the increased quality and availability of fodder (Figure 1).

Considering the 20-year capitalization phase and cumulative impact of the project to 2042, the project is expected to yield -7,442,209 t CO_2e over 20 years, or -744,221 t CO_2e per year less total GHG emissions compared to WOP. The project is expected to result in 12,955 t more protein over the 20-year timeframe (1,295 t per year).

FIGURE 1. Results of the ex-ante assessment comparing the scenarios with (green) and without (blue) RRPCP in 2042



Input to the NDC update comparing 2025 and 2030 with 2022

The absolute emissions in the WP scenario (1,611,950 t CO_2e/year) were 11% lower than without the project in 2025 (1,811,416 t CO_2e/year), and 24% lower in 2030 (2,114,342 t CO_2e/year). The emissions intensity with the project was calculated as 46 t CO_2e/t protein, 21% lower in both years than the 58 t CO_2e/t protein without the project. The total annual protein production in the WP scenario was 35,001 t. This figure was 12% higher than the WOP scenario in 2025 (31,135 t protein), but 3% lower in 2030 (36,257 t protein). The higher figure for business-as-usual in 2030 was mainly due to the rising number of animals, whereas the project is forecast to control animal numbers.

It is important to note that the animal numbers in the country are likely to increase and contribute further to protein production. Similarly, the animal numbers in the future may not increase as strongly as it has been projected in the WOP scenario since the project also aims to introduce culling and improve herd management. The carbon sequestration potential of pastures in the RRPCP has not been reflected in the results since it is accounted for separately in the NDC update. The emissions presented here are only the direct emissions. The figures reflect the results for particular years, and are not cumulative changes (Figure 2).

FIGURE 2. Input to NDC update (direct emissions comparing the scenarios with (green) and without (blue) RRPCP in 2025 and 2030) (part 1)

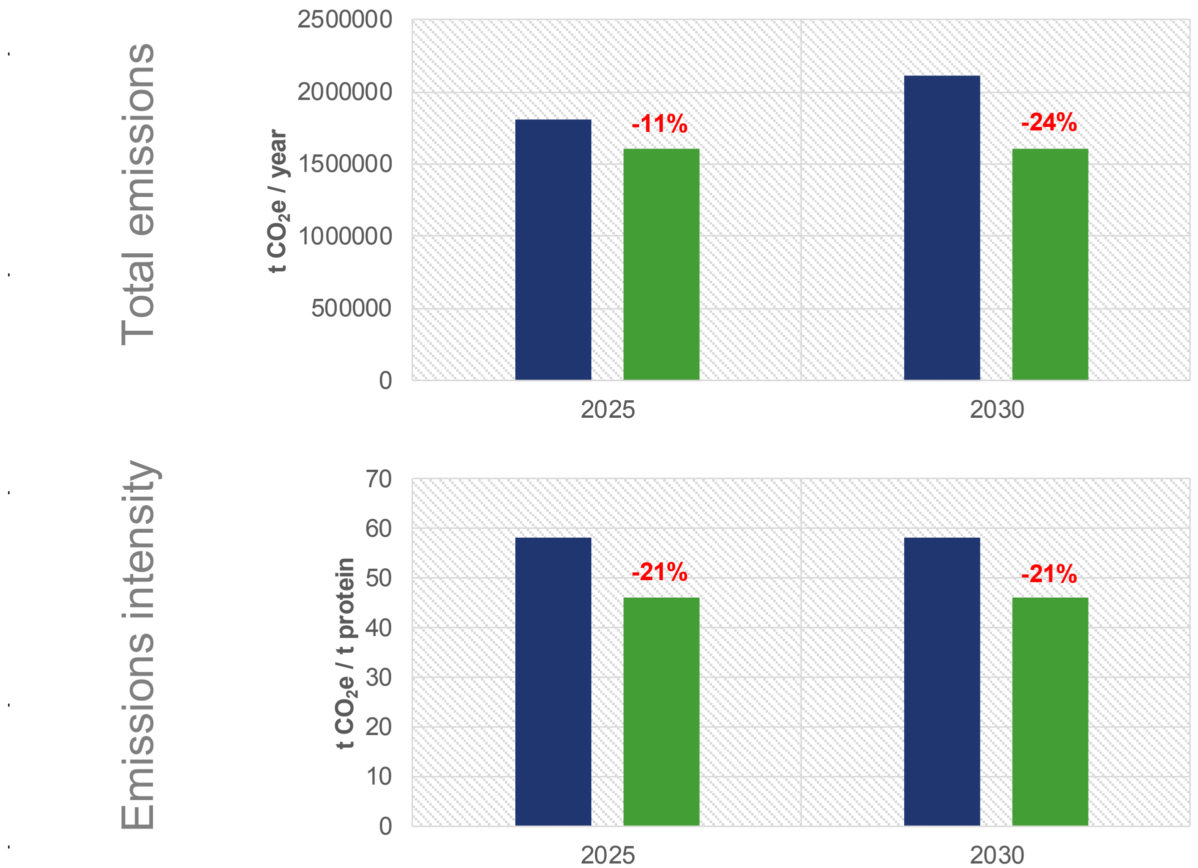
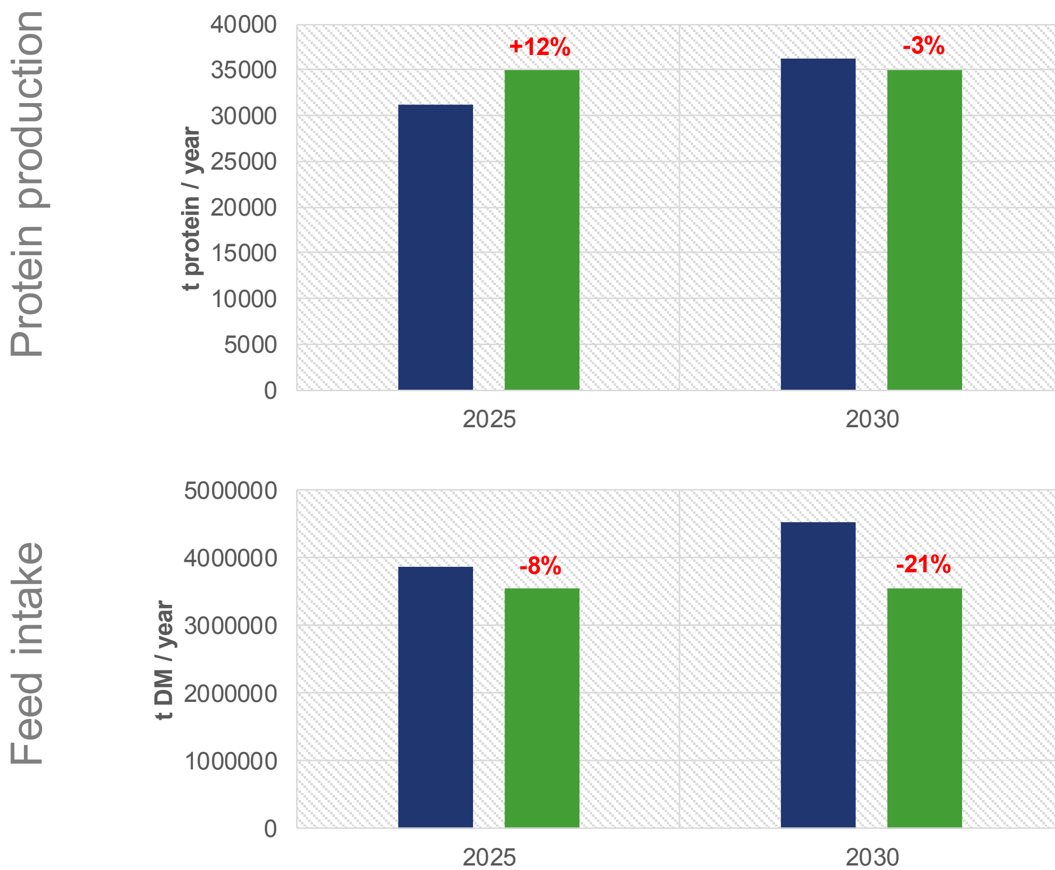


FIGURE 2. Input to NDC update (direct emissions comparing the scenarios with (green) and without (blue) RRPCP in 2025 and 2030) (part 2)



Recommendations and reflections

Livestock are part of the solution to combat climate change in Kyrgyzstan. The assessments show that it is possible for Kyrgyzstan to boost its livestock production and reduce its greenhouse gas emissions at the same time. Increases in animal numbers without the necessary measures (i.e., WOP in 2030 in the results of NDC update) result in higher emissions (in spite of the greater protein production coming from the increased number of animals). However, this study shows that there are options to produce more milk and meat but at the same time lowering emissions and without increasing livestock numbers (as in the case of year 2025 in the NDC input and 2042 in the overall project assessment).

Key measures to reduce GHG emissions

RRPCP can promote a combination of measures to improve herd structure, reduce mortality rates and improve the quality of feed.

- **Breeding cows at an earlier age.** Breeding cows at a slightly younger age would reduce the number of female calves needed for replacement. This, in turn, decreases the number of meat animals in the herd, shrinking the overall herd size. The same amount of protein can therefore be produced with fewer animals, reducing both the total emissions and the emissions intensity (i.e., emissions per unit of product).

- **Improving animal health**. Healthy animals produce more meat and milk than sick animals do. Vaccination and better veterinary services are thus crucial for reducing mortality rates and for increasing milk and meat production. When animals are healthier, owners do not need to keep as many of them – it is better to keep fewer, more productive animals than a large herd of less- or non-productive animals.
- **Producing quality fodder.** Production of quality fodder is key to addressing GHG emissions. Better-quality feed helps keep animals healthy and productive. Quality feed from locally grown ingredients can reduce CH_4 emissions from enteric fermentation and has fewer CO_2 emissions from transport than with imported feed. In order to reduce emissions, the amount of low-quality hay in animal diets can be reduced and the consumption of more nutritious crops, such as the sugar beet residues and maize silage can be increased. Growing more fodder crops also reduces grazing pressures on nearby pastures, which are often degraded. Introducing more energy-efficient ways to produce and process the feed will reduce the CO_2 emissions associated with feed.
- **Improving pasture management**. Healthy and productive pastures are not only the most important source of feed in Kyrgyzstan but also an important store of carbon. A recent study on pasture conditions in Kyrgyzstan shows that the majority of pastures are degraded (EO4SD 2021). Good practices to improve pasture health include pasture resting, rotational grazing on seasonal pastures, protection of water sources, and managing herd growth.

Storing and managing manure

Even though manure is not specifically targeted in the project, some improvements are suggested to increase the share of solid storage. Manure can be a source of both CH_4 and N_2O emissions and there may be trade-offs between these two gases depending on the type of management system. For example, CH_4 emissions may be higher when manure is stored in liquid form, while N_2O emissions may be higher in dry-lot or solid systems (read more). However, emissions from manure are usually low in most systems where manure is stored in solid form. What is important to note here is that manure is a rich source of nutrients and organic matter that is key for soil health and fertility and can contribute to a more circular bioeconomy.

More research needed to understand the impacts of feedlots

There is a growing interest in feedlot systems in the country. The impact of feedlot cattle production systems on GHG emissions was out of the scope in this study. However, some recommendations can be drawn. On one hand, feedlot systems can contribute to food security by raising a large number of animals in a shorter period. The high productivity in this case may lead to lower emissions produced per kg of meat compared to grassland systems. On the other hand, these systems require special diet composition in different periods e.g., high fibrous ingredients in growing period, and high-energy grains during finishing. This can lead to two challenges: i) Feeding ruminants too much cereal can cause health problems; and ii) if the feed is imported, this can lead to increases in CO_2 emissions associated with feed production, processing and transport. Therefore, before such decisions are taken, emphasis should be given to the source and type of feed that will be fed. In addition, systems like feedlots where animals are concentrated in small areas can lead to challenges in manure management and eventually higher emissions as well as water pollution. Finally, they also raise issues in terms of animal health and animal welfare.

References

Demir, P., Aydin, E., and Bozukluhan, K. (2017). The assessment of production loss caused by foot-and-mouth disease on animal farms in the northeast Anatolia Region in Turkey. *J Vet Med Res* 4(3): 1079

CR EO4SD, IFAD, GIZ and the State Agency on Land Resources under the Government of Kyrgyz Republic. (2021). Technical note: Pasture condition maps in Kyrgyzstan. IFAD, Rome.

GIZ, FAO, IFAD. (2021). Analysis of livestock and pasture sub-sectors for the NDC revision in Kyrgyzstan. Bishkek.

Government of Kyrgyzstan (2016). Third National Communication of the Kyrgyz Republic under the UN Framework Convention on Climate Change. Bishkek.

FAO. (2020). *Global Livestock Environmental Assessment Model – Interactive (GLEAM-i). Guidelines, Version 1.9.* http://www.fao.org/3/cb2249en/cb2249en.pdf

IFAD. (2019). Resilient Pastoral Livelihoods Project design report.

IPCC. (1996). Climate change 1995: The science of climate change: contribution of working group I to the second assessment report of the Intergovernmental Panel on Climate Change (Vol. 2). Cambridge University Press.

Myhre, G., Shindell, D., and Pongratz, J. (2014). Anthropogenic and natural radiative forcing. In V. B. and P. M. M. Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia (eds), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

The Kyrgyz Republic. (2015). *Intended Nationally Determined Contribution, submission to UNFCCC*. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Kyrgyzstan First/Kyrgyzstan INDC _ENG_ final.pdf

World Bank. (2007). World Bank. 2007. Kyrgyz Republic. Livestock Sector Review: Embracing the New Challenges (World Bank Report 39026). Washington, DC: The World Bank.

Annex 1. Full list of data and assumptions

TABLE A1.1. Herd data and assumptions – baseline and targets of RRPCP

Project targets shown in red

Parameters	Unit	Description & rationale	Cattle	Sheep	Goats
Age at first calving	months	Average age at which adult females have their first parturition, either it is a successful one or not	29 25	23 20	23 19
Death rate of adult animals	%	Annual average percentage of non-intended deaths of animals (males and females) after reaching maturity	6 4.8	7 5.6	7 5.6
Death rate of young females	%	Annual average percentage of non-intended deaths of female animals before reaching maturity	8 6.4	9 7.2	9 7.2
Death rate of young males	%	Annual average percentage of non-intended deaths of male animals before reaching maturity	8 6.4		
Fertility rate of adult females	%	% of calving adult females over the total amount of adult females. This includes born calves that die before reaching maturity	80 82.4	80 unchanged	90 unchanged
Litter size	number	Average number of lambs or kids born in each parturition, including those that die before reaching maturity	-	1.2 1.5	1.1 1.4
Live weight of adult females	kg	Average live weight of adult females once they reach maturity	370 444	55 55	45 45
Live weight of adult males	kg	Average live weight of adult males once they reach maturity	520 624	85 85	60 60
Live weight of meat females at slaughter	kg	Average live weight at slaughter of adult females culled for meat	400 480	55 55	50 50
Live weight of meat males at slaughter	kg	Average live weight at slaughter of adult males culled for meat	470 564	75 75	60 60
Milk fat	%	Average milk total fat content	3.4 3.6	-	-
Milk protein	%	Average milk total protein content	3.5 unchanged	-	-
Milk yield	kg/year	Annual average milk yield per milking cow	2000 2400	-	-
Number of adult reproductive females	head	Number of adult females in the project. The total number of animals in the project is output from the model	See Annex 2 for animal numbers		
Number of adult reproductive males	head	Number of adult males in the project. The total number of animals in the project is output from the model	See Annex 2 for animal numbers		
Parturition interval	days	Average interval between two parturitions	-	365 unchanged	365 unchanged
Replacement rate of adult females	%	Annual average rate of reproductive adult female replacement	15 12	15 12	15 12
Weight at birth	kg	Average live weight of offspring at birth	40 44	5 unchanged	3 unchanged

TABLE A1.2. Feed parameters and assumptions

Project targets shown in red. Baseline obtained through stakeholder consultations and expert opinions. Values are percent share of each feed ingredient of the total dry matter fed on average per year. Totals equal 100.

Feed ingredient	Description	Cattle	Sheep	Goats
By-products from sugar beet	Known as 'beet pulp', is the remaining material after the juice extraction for sugar production from the sugar beet (*Beta vulgaris*)	0 5	0 5	0 5
Crop residues from maize	Fibrous residual plant material such as straw, brans, leaves, etc. from maize (*Zea mays*) cultivation	0 5	0 5	0 5
Crop residues from other grains	Fibrous residual plant material such as straw, brans, leaves, etc. from barley (*Hordeum vulgare*), rye (*Secale cereale*) or oat (*Avena sativa*) cultivation	10 0	10 0	10 0
Crop residues from wheat	Fibrous residual plant material such as straw, brans, leaves, etc. from wheat (*Triticum* spp.) cultivation	10 4	3 0	3 0
Fresh grass	Any type of natural or cultivated fresh grass grazed or fed to the animals	40 36	60 54	60 54
Fresh mixture of grass and legumes	Fresh mixture of any type of grass and leguminous plants that is fed to the animals	10 10	7 7	7 7
Grains	Grains from barley (*Hordeum vulgare*), oat (*Avena sativa*), buckwheat (*Fagopyrum esculentum*) and fonio (*Digitaria* spp.)	0 5	0 0	0 0
Hay or silage from alfalfa	Hay or silage from alfalfa (*Medicago sativa*)	10 8	10 10	10 10
Hay or silage from grass and legumes	Hay or silage produced from a mixture of any type of grass and leguminous plants	10 7	10 5	10 5
Molasses	By-product from the sugarcane sugar extraction	0 2	0 0	0 0
Silage from whole grain plants	Silage from whole barley (*Hordeum vulgare*), oat (*Avena sativa*), buckwheat (*Fagopyrum esculentum*) and fonio (*Digitaria* spp.) plants	10 4	0 0	0
Silage from whole maize plant	Silage from whole maize (*Zea mays*) plant	0 14	0 14	0 14

Annex 2. Animal numbers

TABLE A2.1. Animal numbers and sources of data in baseline and for scenario without the project

Item	Baseline	Reference	WOP projected[1]		
	2022		2025	2030	2042[2]
CATTLE					
Number of cattle in Kyrgyzstan	1,883,105	2022 projection by UNIQUE (National stats in 2019: 1,680,750)	2,085,461	2,422,720	
Number of cattle in household systems	941,553	World Bank (2007) (50% of total)	1,042,731	1,211,360	
% of population covered in the project	70%	RRPCP design report (IFAD, 2019)			
Number of cattle in the project	659,087	70% of 941,553	729,911	847,952	
Number of adult females in the project	231,000	GLEAM-*i* calculations (for 2042, the baseline was increased by 20%)	255,500	296,800	277,200
Bull to cow ratio	1:25	Stakeholder consultations			
Number of adult males in the project	9,240	0.04 x 231,000 (for 2042, the baseline was increased by 20%))	10,220	11,872	11,088
Number of adult males in the project WP	-	Expert opinions (80% reduction)		1,848	
Number of cattle in the project	659,700	GLEAM-*i* calculations	729,668	847,615	791,640
SHEEP & GOATS					
Number of sheep and goats in Kyrgyzstan	7,095,429	2022 projection by UNIQUE (National stats in 2019: 6,266,739)	7,924,119	9,305,269	
Number of sheep in Kyrgyzstan	5,6763,43	Calculated from FAOSTAT 2014 (4/5 of total for sheep and goats)	6,339,295	7,444,215	
% of population covered in the project	70%	RRPCP design report (IFAD, 2019)			
Number of sheep in the project	3,973,440	70% of 5,676,343	4,437,507	5,210,951	
Number of adult females in the project	1,422,200	GLEAM-*i* calculations (for 2042, the baseline was increased by 20%)	1,588,100	1,865,000	1,706,640
Male to female ratio	1:25	Stakeholder consultations			

[1] UNIQUE calculations based on projected GDP agriculture
[2] Baseline was increased by 20% for 2042

Number of adult males in the project	56,888	0.04 x 1,422,200 (For 2042, the baseline was increased by 20%)	63,524	74,600	68,266
Number of sheep in the project	3,973,567	GLEAM-*i* calculations	4,437,082	5,210,729	4,768,278
Number of goats in Kyrgyzstan	1,419,086	Calculated from FAOSTAT 2014 (1/5 of total for sheep and goats)	1,584,824	1,861,054	
Number of goats in the project	993,360	70% of 1,419,086	1,109,377	1,302,738	
Number of adult females in the project	327,000	GLEAM-*i* calculations (for 2042, the baseline was increased by 20%)	3655,00	429,000	392400
Male to female ratio	1:25	Stakeholder consultations			
Number of adult males in the project	13,080	0.04 x 327,000 (for 2042, the baseline was increased by 20%)	14,620	17,160	15,696
Number of goats in the project	993,014	GLEAM-*i* calculations	1,109,929	1,302,762	1,191,617

Investing in rural people

International Fund for
Agricultural Development
Via Paolo di Dono, 44
00142 Rome, Italy
Tel: +39 06 54591
Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org

facebook.com/ifad
instagram.com/ifadnews
linkedin.com/company/ifad
twitter.com/ifad
youtube.com/user/ifadTV

July 2021