Sustainable Development Goals and the livestock sector in Central Asia
A course outline
Sarah Robinson & Martin Petrick

Working Paper 02-2021
February 2021
Abstract

The livestock sector contributes greatly to human nutrition and economic wellbeing, but it is also associated with negative impacts on the environment and human health. This document outlines a course which examines the sector through the framework of the Sustainable Development Goals, examining trade-offs and synergies between different goals associated with pasture use, intensification, commercialisation and livestock product consumption. The course introduces the international literature on each of these topics and examines the issues raised in detail for the Central Asian region, considering the importance of SDG synergies and trade-offs for different types of producer, and asking how government policies can maximise the contribution of livestock towards the achievement of SDGs.

Keywords: livestock, SDGs, teaching module, Central Asia.

JEL codes: A23, P28, Q12, Q56.
# Table of Contents

Abstract .................................................................................................................................................................... 2
Sustainable Development Goals: trade-offs in the livestock sector ............................................................. 5
List of Units ............................................................................................................................................................. 6
Course Requirements ............................................................................................................................................ 7
Learning Outcomes ............................................................................................................................................... 7
Introductory Reading ............................................................................................................................................. 8
Unit 1. Livestock producers in Central Asia ...................................................................................................... 9
Unit 2. Extensive livestock production and the environment: grazing and pastures ............................... 11
Unit 2. Summary and references ...................................................................................................................... 12
Unit 3. Intensification and livestock productivity .......................................................................................... 13
Unit 4. Commercialisation: value chains, trade and agricultural policy ..................................................... 15
Unit 5. Human nutrition and the livestock sector ........................................................................................... 17
Acknowledgements ............................................................................................................................................. 19
About the authors ................................................................................................................................................ 19
Sustainable Development Goals: trade-offs in the livestock sector

The livestock sector occupies over 30% of the earth’s land surface and has been associated with land degradation, biodiversity loss, high greenhouse gas (GHG) emissions, diminished water quality, low land use efficiency and epizootics. Yet it produces 33% of global agricultural GDP and contributes to the livelihoods and food security of over 700 million poor smallholders. Livestock can use land unsuitable for arable crop production, converting low-quality roughage to protein for human consumption and facilitating nutrient cycling. They contribute fertilizer and traction, and insurance and savings in markets where credit and banking needs are poorly served. Livestock production has been intensifying and increases in efficiency have partially mitigated negative effects. But steeply increasing demand for livestock products and rising intensity of impacts on human health and the environment mean that it is more important than ever to examine the trade-offs associated with the sector in different countries and production systems.

This course examines these trade-offs using a framework based on the Sustainable Development Goals (SDGs; Figure A.). Divided into five units based on various aspects of livestock production, marketing and consumption, international literature on each topic is presented and SDG synergies and trade-offs are discussed, using examples from Central Asia. The course is based on a research review which uses existing literature and statistics to analyse SDG trade-offs in the Central Asian livestock sector, putting these in a global context. This report is a key reference for the course and also reviews much of the literature given in the reading list.

Figure A. SDG trade-offs in the livestock sector

List of Units

There are five units (listed below and in Figure B) covering different aspects of the livestock sector, associated SDG trade-offs and potential synergies. Each includes an overview of the topic, mostly through review papers and textbooks on the global literature, before focussing on the situation in Central Asia. Unit outlines presented here each comprise an introduction to the topic, a table presenting subtopics covered and suggested references for reading. A schematic diagram illustrates links between the topic and SDG areas, as well as the external processes and policies influencing change in the topic area.

**Figure B. List of units and related SDG areas**

**Unit 1. Livestock producers:** Covering different types of livestock producer in terms of farm size, access to land and commercial orientation, this unit examines the objectives of livestock keeping for each group, and looks at relationships between scale, value generation and efficiency. The role of government policy in shaping the producer landscape, and consequences for SDGs are explored.

**Unit 2. Extensive production systems:** This unit looks at extensive grazing systems, including relationships between grazing livestock and vegetation; environmental trade-offs associated with pastoral systems; and benefits in terms of opportunity costs, food security and income for producers. Factors affecting how livestock use and access pasture are described, with a focus on land tenure policy and institutional arrangements.

**Unit 3. Intensification:** This unit covers factors affecting livestock productivity, including fodder, genetics and animal health, and looks at where and how change is occurring in these areas. Environmental trade-offs are examined, as well as routes to sustainable intensification through land access arrangements, irrigation management systems and investments in animal health and genetic improvement.

**Unit 4. Commercialisation:** This unit covers value chains, looking in particular at integration of smallholders. Export patterns and trading arrangements are examined, along with other policies affecting agricultural incentives and their impacts on value chains, producers and consumers – including extension and veterinary services, subsidies and credit.

**Unit 5. Human nutrition:** The role of livestock in the nutrition transition is explored, including the contribution of livestock to health where nutrition is limiting, or to ill-health in a context of over-nutrition. The unit covers recent trends in consumer demand for livestock products related to income growth and urbanisation, and the impacts on producers and health.
Course Requirements

- Economic principles of farm management (rationality principle, opportunity costs, productivity vs efficiency vs factor intensity).
- Principles of institutional economics (property rights, principal-agent problems, transaction costs).
- Theories of collective action (social dilemmas & free riding, governance mechanisms market vs government, community governance).
- Theories of consumer behaviour (objectives of human behaviour, dealing with trade-offs, behaviour under risk).
- Key concepts of environmental economics (sustainability, ecosystem services, public and private goods, externalities).
- Basic understanding of biological principles in agriculture (livestock nutrition, soils, carbon and nitrogen cycles).
- Statistical concepts: measures of central tendency and variation.

Learning Outcomes

Students will:

- Develop an understanding of key trade-offs between economic and environmental SDGs in the livestock sector and be able to set up hypotheses regarding potential trade-offs of different livestock systems and development pathways in Central Asia.
- Understand concepts of natural resource management on rangelands, critically evaluate scientific literature on land degradation severity and extent and be able to assess possible impacts of reform policies on environmental and social SDG outcomes.
- Be able to understand the potential social trade-offs related to livestock sector development and commercialisation, including between the poverty and food security SDGs and those related to broader economic growth. They will be able to evaluate how government policies in areas of land reform, producer and market support and trade can promote different SDGs, and favour some types of producer over others.
- Gain a practical understanding of value chains in the livestock sector and an ability to identify or predict the economic and political factors likely to drive or limit smallholder participation in Central Asia.
- Be able to use information on the nutrition transition to suggest hypotheses about links between the livestock sector, diet and health in a Central Asian context.
- Be able to identify key trade-offs, design data-driven approaches for measuring them and conduct trade-off analysis using empirical data.
Introductory Reading

**Livestock and SDGs**


**Livestock and environment**


**Livestock sector development and economics**


**Theory and methods**


Unit 1. Livestock producers in Central Asia

Trade-offs between poverty reduction and zero hunger (1, 2) and decent work and economic growth (8, 9).

The development of farming structures is rooted in the reform processes which Central Asian republics have followed since their common past in the collectivised agricultural systems of the USSR. All five republics share three basic types of agricultural structure – households (HH), individual farms (IF) and large enterprises (E). Moreover, livestock owners keep animals for different reasons ranging from nutrition, food security and insurance to small scale income generation and commercial business. These different objectives are not always included in economic valuations of the livestock sector.

Global literature suggests that in developing economies, large-scale farming by investor-held agro-enterprises is often less efficient than small individual farms, as well as leading to poorer social outcomes in terms of employment and income. There is some evidence for this in Central Asia, in that the advent of private farming is associated with the post-transition recovery and increases in crop yields. But in livestock production scale may have productive advantages, for example concerning pasture use. Land access is associated with poverty reduction, but in many countries, reform was highly inequitable. The majority of livestock remain in households and small farms, which have very small land holdings. Land access distributions, land markets, and potential for employment outside agriculture all have important implications for sector commercialisation and intensification.

Unit 1. The producer landscape of households, farms and enterprises and the relative proportions of land and livestock within each has been largely determined by reform and restructuring (grey boxes). The resulting farming configurations influence multiple SDG targets and indicators (red boxes).
Unit 1: Summary and references

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global patterns and trends</td>
<td></td>
</tr>
<tr>
<td>Different producers, different functions</td>
<td>Global livestock production systems</td>
</tr>
<tr>
<td></td>
<td>Functions of livestock in low and middle income countries</td>
</tr>
<tr>
<td></td>
<td>Objectives of different producers</td>
</tr>
<tr>
<td>Structural change and farm scale</td>
<td>Global trends in farm scales</td>
</tr>
<tr>
<td></td>
<td>Relationship between farm size, productivity and efficiency</td>
</tr>
<tr>
<td></td>
<td>Socialist agriculture</td>
</tr>
<tr>
<td></td>
<td>Role of land markets</td>
</tr>
<tr>
<td>Central Asia</td>
<td></td>
</tr>
<tr>
<td>Agricultural reform</td>
<td>Reform trajectories and policies</td>
</tr>
<tr>
<td></td>
<td>Farm structures and land access</td>
</tr>
<tr>
<td></td>
<td>Trends in livestock inventories by farm structure</td>
</tr>
<tr>
<td></td>
<td>Land relations between different actors</td>
</tr>
<tr>
<td>Production outcomes of reform</td>
<td>Trends in overall value of the livestock sector</td>
</tr>
<tr>
<td></td>
<td>Volume of livestock products by farm structure</td>
</tr>
<tr>
<td></td>
<td>Yields and animal performance</td>
</tr>
<tr>
<td></td>
<td>Technical efficiency at the farm level</td>
</tr>
<tr>
<td>Social impacts of farm restructuring</td>
<td>Impact on poverty and employment</td>
</tr>
<tr>
<td></td>
<td>Impacts on nutrition</td>
</tr>
</tbody>
</table>

Key references


Additional reading


Unit 2. Extensive livestock production and the environment: grazing and pastures

Trade-offs between poverty reduction & zero hunger (1, 2) and life on land (15) & climate action (13). Trade-offs between economic growth (8, 9) and life on land (15) & climate action (13).

Central Asian grazing systems were traditionally based on the exploitation of temporal and spatial variability in pasture quality and quantity. Thus, animal mobility is important for both productivity and sustainable pasture management. Today, administrative, economic and physical factors impose high transaction costs to seasonal pasture use. These barriers are often insurmountable for smallholders, with associated food security and poverty implications, but they can be lowered by infrastructure investment and institutional arrangements. Moderate grazing is important for fire control and for the wildlife and vegetation which co-evolved with rangeland ungulates, so livestock production can be more compatible with conservation than use of cropland for fodder production. Moreover, conversion of cropland to pasture is an important carbon sequestration mechanism. Conversely, products from grazing livestock have a higher carbon footprint than those from more intensive systems, due to methane emissions from enteric fermentation. Lack of grazing management institutions and systems has led to underuse of pastures in some areas and overuse in others with implications for livestock productivity, vegetation and soils. More broadly, economic growth associated with transport infrastructure, mining and urban development may negatively affect rangeland resources for livestock.

Unit 2. Patterns of pasture access and use by livestock are determined by numerous social, political, economic and climatic processes (grey boxes). The outcomes on interlinked SDG targets are symbolised by the green boxes.
Unit 2. Summary and references

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Global patterns and trends</strong></td>
<td></td>
</tr>
<tr>
<td>Global pastoral systems</td>
<td>• Global significance of extensive grazing systems</td>
</tr>
<tr>
<td></td>
<td>• Pastoral resources – threats and opportunities</td>
</tr>
<tr>
<td></td>
<td>• Pastoral property rights systems</td>
</tr>
<tr>
<td>Environmental trade-offs associated with pasture use</td>
<td>• GHG emissions, biodiversity, vegetation and soils</td>
</tr>
<tr>
<td><strong>Central Asia</strong></td>
<td></td>
</tr>
<tr>
<td>The pastoral resource</td>
<td>• The biological basis for historical grazing patterns</td>
</tr>
<tr>
<td></td>
<td>• Factors limiting livestock production</td>
</tr>
<tr>
<td>Transition, reform and grazing systems</td>
<td>• Impacts of transition on grazing patterns</td>
</tr>
<tr>
<td></td>
<td>• Property rights policy post-independence</td>
</tr>
<tr>
<td></td>
<td>• Costs and consequences of mobility loss</td>
</tr>
<tr>
<td>Impacts of grazing on land</td>
<td>• Land degradation: severity and distribution</td>
</tr>
<tr>
<td></td>
<td>• Livestock raising and land conversion</td>
</tr>
<tr>
<td></td>
<td>• Grazing and biodiversity</td>
</tr>
<tr>
<td>Climate change and livestock</td>
<td>• Changes in emissions since independence</td>
</tr>
<tr>
<td></td>
<td>• Mitigation in the livestock sector</td>
</tr>
</tbody>
</table>

**Key references**


**Additional reading**


Unit 3. Intensification and livestock productivity

Trade-offs between poverty reduction zero hunger (1, 2) and water availability (6), life on land (15) & climate action (13).

Trade-offs between economic growth (8, 9) and water availability (6), life on land (15) & climate action (13).

Intensification of livestock production towards higher input - higher output systems is often associated with sector commercialisation. But there are a number of barriers to this process in Central Asia. The major determinants of individual livestock performance are climate, nutrition, genetic potential and animal health. In Central Asia winter fodder is a major limiting factor. In areas with access to arable land, crop residues or cheap fodder markets, improved feeding and winter housing combined with genetic improvement may be associated with gains in animal productivity, as well as a reduction in GHG emissions. But elsewhere, expanding farms often find it cheaper to migrate to winter pastures, relying on animal numbers rather than performance to increase product volume. Genetic improvement may still raise productivity but benefits depend on whether breeding programmes are appropriate to climatic conditions and farming systems. Some may result in loss of genetic diversity. Other trade-offs associated with intensification include water pollution and competition of fodder crops with food and cash crops for irrigated land - dependant on inefficient and environmentally damaging water management systems. Fodder costs, and access to cropland, water, winter pasture and high value markets all determine the extent of intensification and the significance of resulting trade-offs.

Unit 3. Livestock productivity depends on climate, feeding, genetic potential of animals and veterinary systems. Intensification may be influenced by factors such as land access, water management systems and markets (grey boxes) and in turn influences multiple SDGs (blue boxes).
Unit 3. Summary and references

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Summary</th>
</tr>
</thead>
</table>
| Global patterns and trends | ■ Determinants of livestock productivity  
■ Intensification and productivity gains  
■ Drivers of intensification  
■ Environmental trade-offs and sustainable intensification  
■ Land use opportunity costs  
■ Social and economic trade-offs  
■ Genetic diversity  
■ Principles of integrated water resource management  
■ World experience in irrigation management transfer |

| Central Asia | |
|-------------| |
| Fodder availability in Central Asia | ■ The winter feed bottleneck  
■ Increasing fodder and feed availability  
■ Determinants of intensification of feeding |
| Irrigation water: demand and management | ■ Irrigation problems in Central Asia  
■ Institutions for water management |
| Genetic potential, animal health, zoonotic disease | ■ Breeds and improvement programmes.  
■ Animal health and impact on the livestock sector |

**Key References**


**Additional reading**


Unit 4. Commercialisation: value chains, trade and agricultural policy

Trade-offs between poverty reduction and zero hunger (1, 2) and decent work and economic growth (8, 9).

Sales of livestock products and development of associated processing industries supply domestic markets, generate income and taxes and provide export revenue. But participation in formal value chains with high quality and food safety standards may be out of reach for smallholders, who mostly sell through informal markets. Policy makers and firms often prefer large farming units with capacity to supply quality and quantity of product to support processing and export industries. But if commercialisation of agriculture is achieved to the detriment of small farmers then trade-offs may arise between growth in the agricultural sector and poverty reduction. The ability of small farmers to grow, commercialise and specialise is strongly influenced by the economic and policy environment – which also affects the willingness of private firms to work with small suppliers. Government policies in trade, land reform, subsidies, infrastructure, credit and agricultural service provision all affect agricultural incentives and commercialisation. In particular investment in public goods such as infrastructure, extension and veterinary services, combined with development of cooperatives and contract farming have potential to improve smallholder participation in value chains, but this potential is as yet largely unrealised in Central Asia.

Unit 4. Future patterns of commercialisation could include vertical integration or vertical coordination and may integrate smallholders to greater or lesser extents. These factors will be determined by social, political and economic processes (grey boxes) whilst the outcomes on interlinked SDGs are symbolised by the orange boxes.
## Unit 4. Summary and references

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Summary</th>
</tr>
</thead>
</table>
| **Global patterns and trends** | - Growth and trends in global value chains  
- Winners and losers of value chain development  
- Impact of trade and investment policy on agricultural incentives and rural living standards. |
| **Value chain structures and smallholder integration** | - Vertical integration  
- Contract farming and technology transfer  
- Cooperatives |
| **Central Asia** | |
| **Value chains in Central Asia** | - Milk value chains  
- Beef value chains  
- Contracts and cooperatives |
| **Trade arrangements and export barriers** | - Trading arrangements in Central Asia  
- Import and export of livestock products  
- Trade control instruments |
| **Government support to agriculture** | - Budgetary support for agriculture  
- Finance and subsidies  
- Extension and technology transfer |
| **Economy wide impacts of policies** | - Total government support indicators  
- Distortions to agricultural incentives |

### Key References


Catelo, M. A. O. and A. C. Costales. 2008. Contract farming and other market institutions as mechanisms for integrating smallholder livestock producers in the growth and development of the livestock sector in developing countries. Pro-Poor Livestock Policy Initiative & FAO.


### Additional reading


Unit 5. Human nutrition and the livestock sector

Trade-offs between decent work and economic growth (8, 9) and overnutrition (2), resulting in obesity and rising human health burden.

The nutrition transition describes the trend in developing countries from widespread malnutrition, characterised by calorie deficiencies, to overnutrition and rising prevalence of obesity and non-communicable diseases such as diabetes and heart disease. These changes are associated with increased consumption of sugar, processed foods, and animal products – strong increases in demand for the last of these has been called ‘the livestock revolution’. In Central Asia, undernutrition and micronutrient deficiency are still significant but some areas are starting to experience a triple nutritional burden, as these deficiencies co-exist with rising overnutrition. Thus, amongst low income households, access to livestock products may be associated with positive health outcomes, whilst the relationship is likely to switch at higher incomes as animal product intake increases. At the same time, the nutritional status of Central Asian populations is vulnerable to shocks. Dependence on remittances and food imports makes the region sensitive to geo-political upheavals and commodity prices - with potentially rapid dietary and health implications.

Unit 5. Availability and intake of livestock products are influenced by increasing incomes, urbanisation and trade policies, and external shocks (grey boxes). The outcomes on interlinked SDGs include different dimensions of nutritional status, health and resilience, of which livestock raising is one aspect (beige boxes).
Unit 5. Summary and references

<table>
<thead>
<tr>
<th>Sub-Topic</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global trends and patterns</td>
<td></td>
</tr>
<tr>
<td>Global consumption of livestock products</td>
<td>The nutrition transition&lt;br&gt;The livestock revolution&lt;br&gt;Positive contribution of livestock to diet, health and food security&lt;br&gt;Negative contribution of livestock: obesity and disease&lt;br&gt;The role of trade in the nutrition transition</td>
</tr>
<tr>
<td>Central Asia</td>
<td></td>
</tr>
<tr>
<td>Human health Central Asia</td>
<td>Food security and undernourishment&lt;br&gt;Obesity and the nutrition transition&lt;br&gt;Trends and prevalence of non-communicable diseases&lt;br&gt;Determinants of malnutrition</td>
</tr>
<tr>
<td>The role of livestock in diet and health</td>
<td>Overall dietary composition and trends&lt;br&gt;Trends in livestock product availability and intake&lt;br&gt;Contribution of livestock sector to health outcomes</td>
</tr>
</tbody>
</table>

**Key references**


**Additional reading**


WHO. 2017. FEEDcities project. The food environment description in cities in Eastern Europe and Central Asia - Kyrgyzstan. WHO.
Acknowledgements

Course outline produced in 2021 by Sarah Robinson and Martin Petrick at the Centre for International Development and Environmental Research (ZEU), Justus Liebig University Giessen, Senckenbergstrasse 3, 35390 Giessen, Germany. The work was funded by the German Academic Exchange Service (DAAD) from funds of Federal Ministry for Economic Cooperation (BMZ), SDGnexus Network (grant number 57526248), program “exceed - Hochschulexcellenz in der Entwicklungszusammenarbeit”.

About the authors

Dr. Sarah Robinson has worked on rural livelihoods and pastoralist systems in Central Asia since 1997, focussing on the interaction of biological, economic, and political factors on pastoralists and wildlife. She has recently contributed to the project ‘Revitalising animal husbandry in Central Asia: A five-country analysis’ at the Leibniz Institute of Agricultural Development in Transition Economies (IAMO) in Halle (Saale), Germany, and is a visiting researcher at the Interdisciplinary Centre for Conservation Science at Oxford University, UK. Dr. Robinson works as a consultant for the SDG Nexus Network.

Prof. Dr. Martin Petrick is a professor of agricultural, food and environmental policy and a member of the Center for International Development and Environmental Research (ZEU) at Justus Liebig University Giessen, Germany. He is also a Visiting Researcher at the Leibniz-Institute of Agricultural Development in Transition Economies (IAMO) in Halle (Saale). A trained agricultural economist, he has studied agricultural development in Central Asia since the late 1990s, with a focus on farm restructuring as well as land, labour and water governance. He has worked in senior positions for the World Bank, Asian Development Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and other institutions. Prof. Petrick is a member of the management board of the SDG Nexus Network.
This publication is licensed for use under a Creative Commons Attribution 4.0 International License (CC BY 4.0). Subject to attribution, you are free to share (copy and redistribute the material in any medium or format), adapt (remix, transform, and build upon the material) for any purpose, even commercially.

Authors: Sarah Robinson and Martin Petrick


Front cover photo: Sarah Robinson