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Assessing the contribution of livestock systems to development in drylands: indicators for appropriate public policies

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In drylands, scientific research shows that mobile livestock systems derive the maximum social, environmental and economic benefits from these areas. These systems ensure both short-term security in case of shocks and, in the right conditions, investment capacity. However, it is difficult to develop indicators to understand and assess their contribution to territorial development, as they sit at the intersection between several scales of space and time, as well as of social and institutional organisation. The operational framework proposed here is aimed at rethinking the role livestock

systems play in the sustainability of resources and societies in drylands. Six types of development indicators compare these three dimensions: characteristics of herds and of goods and services provided by the species bred, herd size, herd management system, management of land and resource use, access to state support, and dependence on markets. This framework invites policymakers to integrate these different scales in order to understand the adaptation mechanisms and the risks associated with intervention.

Until the 2000s, in drylands (encompassing the world's arid, semi-arid and dry sub-humid regions), governments and financing agencies generally paid little attention to livestock systems, which were nevertheless traditionally very present in pastoral and agropastoral forms. This lack of attention was reflected in the Poverty Reduction Strategy Papers (PRSPs) of many African countries. With the exception of animal health, the livestock sector and its stakeholders have rarely been included in the policy dialogue. There are several reasons for this: first, few livestock farmers' groups are recognised by the state and, second, livestock farmers have little access to land ownership or are physically remote from local and national decision-making centres, which limits their influence. Some countries even lack reliable statistics on herd numbers or trade flows. However, more and more scientific evidence is showing the real and potential contribution of livestock systems to the economic and social development of territories and to ecosystem conservation. These livestock systems are a way of life (social and human value), as well as an activity that ensures socio-economic diversification in rural areas (economic value), and a factor of adaptation to change (resilience and efficiency). But what is the best way to understand, articulate and measure these dimensions in order to support policymakers in the livestock sector?

Mobility, a constituent of livestock systems in drylands

Pastoral and agropastoral livestock systems are characterised by their mobility: herds move on local, national and even transnational scales. Agropastoral systems also include agricultural activities (food crops).

For families living in drylands, livestock farming is a means of adapting to uncertainty, such as climate variability, soil degradation and agricultural price fluctuations. This buffer stock is also a way to cope with unexpected expenses (family events) and natural or economic disasters. Livestock is often the last asset that can be mobilised during long droughts before having to look for work elsewhere (rural exodus, whether temporary or permanent).

In 2009, the Food and Agriculture Organization of the United Nations (FAO) reported that 70% of the world's 1.4 billion poorest people depended on livestock for their livelihood. Almost 39% of all people living in drylands rely on livestock activities for their living. Livestock systems in these regions play a key role in coping with shocks, through their many products and services, such as milk and meat for family consumption, livestock trade and transactions to guarantee purchasing power or investment, transport, employment and family savings that provide social and financial security. In the most densely populated territories, farmers even tend

to develop small livestock systems (a few sheep and goats grazing the roadside, crop residues or land unsuitable for farming) in order to diversify their income and to deal with land fragmentation caused by demographic pressure; this is the case in Egypt and India.

Appropriate scientific indicators for development policies

In drylands, scientific research has accumulated a lot of evidence to show the effectiveness of mobile livestock systems in achieving the three dimensions of sustainable development: social, economic and environmental. This evidence invites policymakers and donors to change their perspective on this activity. It is not an archaic activity that simply needs to be modernised by regulating its movements. On the contrary, it should be seen as a modern activity that derives the maximum social, environmental and economic benefits from drylands.

To ensure that coherent public policies and instruments can be implemented for sustainable pastoral and agropastoral livestock systems, it is necessary to produce indicators to understand and assess their contribution to the economy and to territorial development. The fact that these livestock systems are by nature situated at the junction between different spatial and temporal scales makes it difficult to develop indicators, and therefore complicates the creation of a common framework for understanding and assessing their performances.

Faced with this challenge, since the 2000s, a variety of integrated approaches have been proposed. These scientific approaches use multicriteria methods that are often quantitative, or systemic methods that are found in works on resilience.

More operational approaches also exist to assess the socio-economic and environmental sustainability of livestock activities in a given territory or at the national level, to enable policymakers to discuss pathways to sustainable development. These "toolkits" provide a set of indicators that give a multidimensional vision of the contribution of livestock systems – examples include (see box below), the LS IPT operational guide (Livestock Sector Investment and Policy Toolkit) and the IMPACT platform (Integrated Modelling Platform for Animal Crop Systems).

These toolkits integrate many different indicators, but they raise complex questions at the interface between scales, especially with asymmetric chains of causality from one scale to another. They always prove insufficient or too limited to take account of all the parameters of these types of livestock systems.

In light of this previous research, both scientific and operational, we propose that these indicators should be approached from a temporal, spatial and organisational perspective in order to improve their operational scope.

A multiscale operational framework to understand mobile livestock systems

The research conducted in several parts of Africa, in parallel to the development of the LS IPT guide, has enabled the design of indicators by meeting two requirements:

- > combining these indicators to take account of interdependencies of timescales in adaptation processes in livestock systems
- > mobilising the spatial and organisational scales, which both determine access to resources.

Time, space and organisation are the three dimensions of the framework of indicators proposed here (see box p. 3).

Five timescales are used: the season (several months), which determines mobility and vegetation availability throughout the year; the year, which regulates herd dynamics; a cycle of several years (4-5 years), corresponding to the behavioural and physiological capacity of livestock to survive and to reproduce in situations of heavy constraint; the intergenerational transmission time (20-30 years); and the non-cyclical long term, in which global changes occur.

The spaces concerned fall into three categories: the living territory of the family (living place), the territory of attachment, where herds traditionally graze, and the territory of engagement, covering distant rangelands and dependence on the state.

The organisational dimension encompasses social and institutional arrangements that facilitate and regulate access to multiple resources, goods and services, both public and private.

For each timescale, the adaptive capacity varies according to the livestock species, their genetic heritage and their biological functioning (indicator ①), the size of the herd bred by the household (②) and the livestock management system for each species (③). For example, during repeated droughts, the lack of feed and the need for cash could force livestock farmers to destock their young females. This sale could compromise the reproductive potential of the herd in the medium term (4-5 years), or even destroy the reproductive stock.

However, the effects differ according to the species. Cattle and camels provide high investment capacity, but the destocking of reproductive females can considerably reduce livelihoods

The LS IPT and IMPACT toolkits

The LS IPT operational guide (Livestock Sector Investment and Policy Toolkit) was produced in the context of a partnership between CIRAD, the World Bank, FAO and the African Union. Its goal is to analyse the role of livestock farming in economic growth and poverty reduction at the level of the livestock system, the household, the sector, the agroecological region and the country. The LS IPT enables the development of action plans aimed at integrating livestock systems into Poverty Reduction Strategy Papers (PRSPs) and national investment programmes. Since 2017, it has been used by FAO to support countries in their strategic livestock development plans. Its advantage is that it builds on the functioning of livestock systems and their many products and services provided at the household scale to understand their real contribution at the agroecological region and country scales.

Alary V., Dutilly C., Bonnet P., Lesnoff M., Juanes X., 2013. LS IPT Toolkit. Manuals. Montpellier, CIRAD.
<https://agritrop.cirad.fr/601492/>

The IMPACT modelling platform (Integrated Modelling Platform for Animal Crop Systems) was developed by the International Livestock Research Institute (ILRI, Nairobi) and its partners. It provides an operational framework to understand and analyse the impact of farming and livestock practices on the livelihoods of small farms in tropical areas. It is also used to test external interventions, such as agricultural policies or agronomic and organisational practices, on farming systems, especially in terms of food security and income. This platform provides standardised data on the diversity of farming systems.

Herrero M., González-Estrada E., Thornton P.K., Hoogenboom G., 2005. IMPACT - Integrated modelling platform for animal crop systems. User's manual Version 1.1. Nairobi, ILRI, 140 p.
<https://hdl.handle.net/10568/1214>

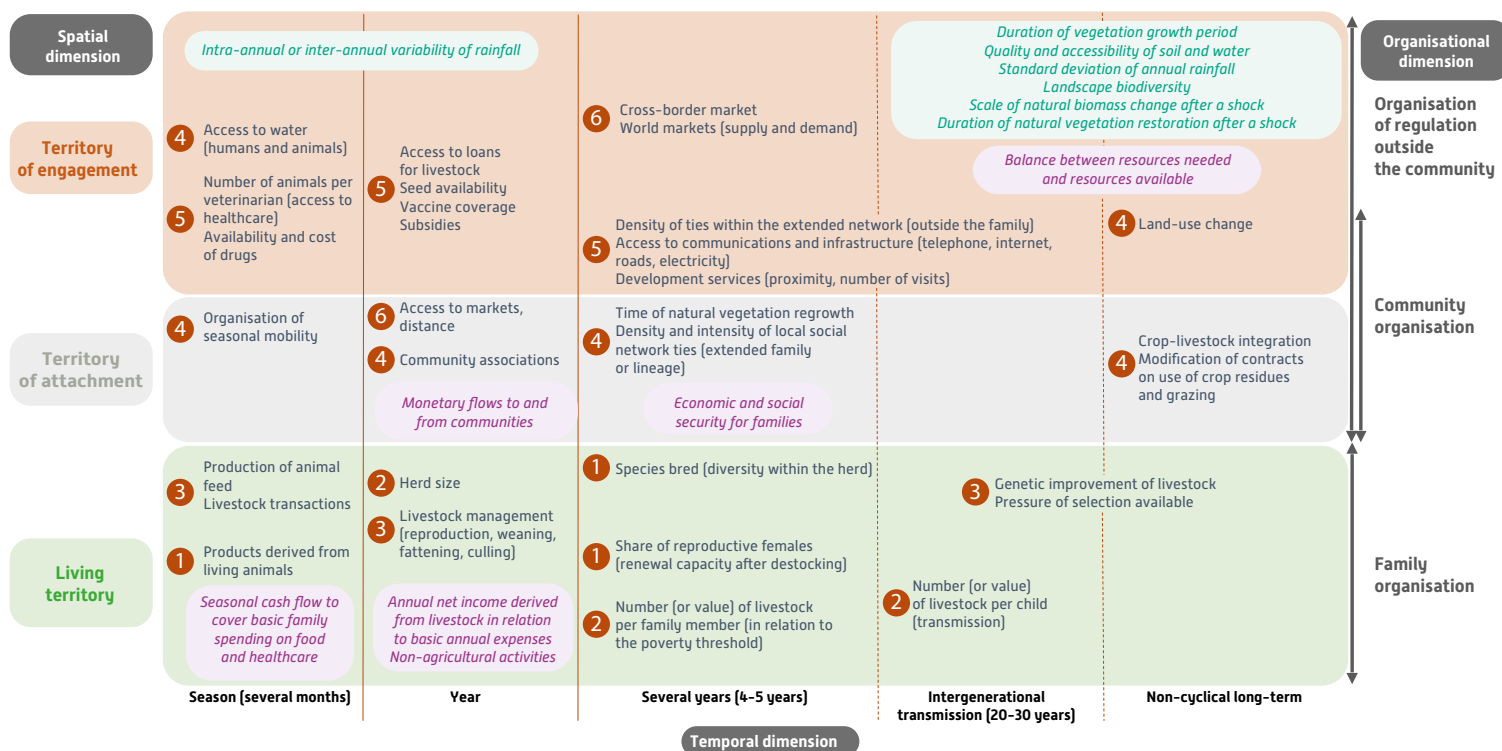
Operational framework of indicators articulated with scales of time, space and social and institutional organisation

In the diagram below, the **timescales** are represented by five columns, going from the short term on the left to the long term on the right. The **spaces** are represented by three bands: living territory, territory of attachment and territory of engagement. The **organisational dimension** is on the right: family organisation is attached to the living territory; community organisation corresponds to the territory of attachment but also extends to part of the territory of engagement; and the organisation of regulation outside the community encompasses the territories of attachment and engagement.

Each number is a type of development indicator, described by the adjacent text: ① characteristics of the herd and of the goods and services provided by each species bred, ② livestock numbers, ③ livestock management, ④ organisation and management of resources at the interface between state regulations and customary practices, ⑤ access to state support for health and production, ⑥ dependence on products and market prices.

The **texts in purple italics** are indicators of results; they show the economic viability derived from the development indicators.

The **texts in green italics** are climate and ecological indicators, over which the stakeholders have no (or little) influence at their individual scale.



in the longer term, given that renewal takes one to two years [variable fertility, the time needed for breeding, more than 9 months of gestation for cattle and 15 months for camels]. However, small ruminants (sheep and goats) are rustic and have a greater renewal capacity [five months' gestation, multiple births]; the management of these species is more flexible when coping with shocks.

Investment capacity depends on the economic value of the herd. In pastoral societies, this value also ensures recognition and trust that facilitates loans or acts as a guarantee to fulfil social obligations, such as marriage. It is the capital that can be passed on to the next generation.

The spatial scale is articulated to each timescale and enables adjustments. The area of herd mobility is found at the level of the territory of attachment, where the traditional social network is structured [such as tribes in North Africa or, more commonly, lineages] (④). This mobility can extend to the territory of engagement, in case of a climate shock or a social conflict in the territory of attachment. The non-community regulation mechanisms are found in the territory of engagement with which livestock farmers interact, in terms of rights, obligations and access to goods and public services (⑤), but they also encompass the territory of attachment. These spatial and organisational scales overlap, especially at the level of the territory of attachment.

Droughts and pastoral laws, with the latter defining pastoral spaces and setting rules of access, have a growing impact on the diversity and availability of vegetation. They can restrict

the mobility of livestock farmers or, on the contrary, extend it into the territories of engagement, areas that are not as safe for farmers (who do not necessarily have their close social network there to protect and support them). As rangelands are shrinking, some African countries have established livestock insurance schemes or feed subsidies. These instruments are aimed at securing cash flow or limiting destocking. But they result in greater dependence on purchased feed (fodder, grain) and, consequently, on the market prices of cattle products and feed (⑥).

Pastoral and agropastoral families are thus continuously adapting the diversity of agricultural and non-agricultural activities and their functions, according to their specific situation and the changing context in which they live. This functioning lies at the intersection of the three dimensions: time, space and social and institutional organisation.

Implications for public policy and research

This operational framework is aimed at reconsidering the place of livestock systems and their role in the sustainability of resources and societies in drylands. For example, a livestock protection or feed distribution operation during a drought, if planned at the scale of a season and a herd, will have impacts not only on livestock numbers in the medium and long term (and therefore on the viability of the households concerned), but also on the management of natural and market resources

at the community or regional level. This type of intervention could result in conflicts or in new natural balances and, as a consequence, the social fabric of livestock farming societies will be altered. Understanding each category of indicators at the different spatial, temporal and organisational scales, as well as their articulations, is essential to understand the impact of any intervention.

This framework invites researchers, experts and administrators in charge of development to go beyond the herd and living territory scales in order to understand the adaptation mechanisms and the potential disruption that could be caused by interventions. It proposes that policymakers should take account of the different spatial, temporal and organisational scales when drawing up livestock action plans.

Perspective n° 60 is based on research conducted by the Joint Research Unit SELMET (Mediterranean and Tropical Livestock Systems, <https://umr-selmet.cirad.fr/en>), and its partners in North Africa and Sub-Saharan Africa. It builds in particular on the following activities and projects:

> the activities conducted in the context of the CGIAR Research Program on Livestock (Livestock CRP, <https://livestock.cgiar.org/>) between 2018 and 2021;

> the CLIMED project, <https://climed.cirad.fr/>, "The Future of Mediterranean Livestock Farming Systems: Opportunity and Efficiency of Crops – Livestock Integration" ANR-12-AGRI-0007 project, 2012-2015 (French National Research Agency – ANR, <https://anr.fr/Projet-ANR-12-AGRI-0007>);

> the production of the LSITP operational guide (Livestock Sector Investment and Policy Toolkit).

Perspective n° 60 draws in particular on the following scientific review: Alary V., Lasseur J., Frijia A., Gautier D., 2022. Assessing the sustainability of livestock socio-ecosystems in the drylands through a set of indicators. *Agricultural Systems* 198: 103389. <https://doi.org/10.1016/j.agsy.2022.103389>

Other publications based on this work include:

Alary V., Messad S., Aboul-Naga A., Osman M. A., Abdelsabour T. H., Salah A.-A. E., Juanès X., 2020. Multi-criteria assessment of the sustainability of crop-livestock farming systems in the reclaimed desert lands of Egypt. *Agricultural Systems* 183: 102863. <https://doi.org/10.1016/j.agsy.2020.102863>

The framework highlights the key indicators that should be regularly monitored in order to design and assess livestock development policies, such as herd size and the share of reproductive females; indicators that are essential to understand the evolution of livestock systems.

Finally, this framework establishes the territory of attachment, which is largely regulated by community organisations, as a key scale for understanding the different processes. Development workers and policymakers therefore need to discuss it and integrate it into their intervention strategies. Built from the viewpoint of "livestock" stakeholders, this framework should be extended to other stakeholders: farmers, foresters, sector stakeholders (processors, retailers, consumers and so on). ■

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