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The Role of Small Scale Livestock Farming In Climate Change and Food Security:

Executive Summary

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This study was conducted as a part of the Vétérinaires Sans Frontières Europa Development Education Program, funded by the European Commission (DEVCO), AFD, Région Rhône-Alpes and DGD. It is concerning the sensitization of students, general public, farmers and policy makers on the importance of Small Scale Livestock Farming in the context of climate variability. The study shows that small scale livestock farming has a potential to cope with and adapt to climatic variability, especially in some determined regions in the world. Moreover, due to its specific functions, small scale livestock farming can also be considered as an important way to mitigate carbon emissions from livestock sector. The Development Education Program, is currently being executed in five countries, with members of the VSF-Europa network, namely Agronomes et Vétérinaires Sans Frontière (France), SIVTRO (Italy), VSF Belgium, VSF Czech Republic and VSF Norway. This study can be considered as a take-off for a campaign that will run for over 3 years and that will sensitize and mobilize people in favour of small scale livestock farming.

Executive Summary

Since the FAO Livestock's Long Shadow Report in 2006, there has been an important increase in research regarding the importance of livestock for food security, the growth of the sector, and the impact on climate change (CC). As of 2000, the livestock sector is estimated to have contributed 18% anthropogenic GHG emissions. Other authors suggest that this value is underestimated and that the real value is of 51% of total GHG emissions. In any case, these emissions make livestock a major target for mitigation options. In addition, livestock sector utilizes 58% of directly used human-appropriated biomass, 70% of agricultural land (from which 33% is for feed crop production) and 30% of land globally. Still, few attempts, addressing the issue of livestock and CC, differentiate among the different categories of livestock farming systems and thus, propose specific policy measures to differentially tackle the problems for each category.

This report aims at contextualizing the role that small-scale livestock farming (SSLF) plays in the CC debate and its potential contribution to food security. The two main hypotheses of the study are that SSLF can contribute to CC mitigation and needs to be considered in policy discussions, and that autonomous adaptation of local communities, mostly based on local traditional knowledge, can be a reliable group of adaptation measures to CC while at the same time contributing to global food security. The questions that this report aims to address can be summarized as follows: (i) how small-scale livestock farming systems are sustainable and could contribute to CC mitigation; (ii) how they are efficient at producing animal source foods for the growing populations and contribute to future food security challenges; (iii) how SSLF communities have traditionally adapted to climate variability and whether these strategies can be valid for CC adaptation. Along this report we will illustrate how SSLF, and particularly pastoralism, may play an important role in these new solutions required.

To address all these issues this report first proposes a different categorization of livestock production systems, going a step further than conventional categories. Our attempt is to introduce in the classification process not only the inputs utilized by different livestock farming systems, but to link this with the scale of each type of production system, so as to add a food system approach to the categories. Later the report critically assesses the existing literature in terms of livestock production and mitigation alternatives. Finally, based on four case studies, it presents the adaptation measures undertaken by small scale livestock farming communities in Turkana (Kenya), Alaotra Lake (Madagascar), Khar-o-Touran (Iran) and Huancavelica (Peru), as well as the main socio-economic drivers intensifying the CC's effects they encounter, which hinder their adaptation capacity.

Categories of livestock farming

The high contribution of livestock farming to GHG emissions is obvious. But, there are multiple ways in which livestock farming can be conducted. In this report, we propose three main categories of livestock farming: small-scale livestock farming (SSLF), which includes pastoralism, small ranching, backyard pig and poultry production, and small mixed farming (both irrigated and rain-fed); medium-scale livestock farming (MSLF), with the highest variability of farming types, including large ranching and large mixed farming (both irrigated and rain-fed); and finally, large-scale livestock farming (LSLF), defined fundamentally by landless industrial production. Classification is made according to differences in farm size, utilization of external inputs, utilization of land, and the type of market to which they have more access and tend to supply.

SSLF approach is holistic adapted to specific socio-ecological contexts. Its main objective is the resilience of the system. The system is characterized by small farms, use of low amount of inputs, being predominantly based on grazing and having more access to local and informal markets. MSLF approach is more reductive, centered on the farm or the animal. Its main objective is the productivity of the system. It is characterized by medium-scale farms, a medium use of inputs and being predominantly based on arable land, with access to local, regional and global markets. LSLF approach is based on profiting from economies of scale, under chrematistic premises. Its main objective is the expansion of the system. It is characterized by large-scale farms, the use of high amount of inputs and no direct use of land, with more access to global markets. The distinction among these categories is crucial since they show radically distinct contributions to the climate issue.

SSLF is the livestock system that competes least for human food, given that it depends primarily on grazing and scavenging. Pastoralism is an activity practiced on 25% of the global land. Some communities practice mobile grazing, others are sedentary, although generally depending on communal grasslands. Ranchers who keep animals extensively on rangelands are found in temperate zones where high-quality grassland and fodder production can support larger numbers of animals. These areas include parts of Europe, North America, South America, parts of Oceania and some parts of the humid tropics. In this case animals are almost exclusively kept for income, and the land tends to be of their own. Another subgroup of SSLF, very spread among sub-urban farms, is backyard pig and poultry production, where livestock is fed through crop residues and scavenging. This system is characterized by being very efficient in recycling residues. Scavenging poultry can provide, according to some estimations, a 600% return on minimum investment. More than 90% of rural families in most developing countries keep one or more poultry species. Finally, mixed farming systems are those SSLF systems where cropping and livestock rearing are more linked activities. Rain-fed mixed farming systems are found in temperate regions of Europe and the Americas and sub-humid regions of tropical Africa and Latin America. They are mostly characterized by individual ownership, often with more than one species of livestock. Irrigated mixed farming systems prevail in East and South Asia, mostly in areas with high population density. Most of small-scale mixed livestock keepers undertake other gainful activities to guarantee their livelihoods. Pastoralism, backyard pig and poultry production, small ranching and small mixed farming are similarly characterized by the high multifunctional role livestock plays – draught power, manure, pest control, crop residues, etc. In total, SSLFS and MSFS together produce 83% of beef meat, 99% of mutton, 45% of pork, 28% of poultry meat and 39% of eggs. Thus, their importance in terms of quantity is considerable, mostly in the case of ruminants.

Despite the importance of SSLF and MSLF, in the last few decades, it has been taking place a notable shift in livestock production, from a local multi-purpose activity (SSLF and MSLF) into market-oriented livestock production systems (LSLF) located close to urban centers. This shift goes with an increasing importance of cereal-fed mono-gastric livestock species, therefore harming ruminants.

Pastoralism with ruminants in grasslands, backyard pig and poultry production with scavenging monogastrics and small mixed livestock farming with ruminants fed with crop residues, are efficient and sustainable methods of providing high-quality protein with minimal environmental impacts, by means of valorizing grasslands and residues. These small livestock keepers leave insignificant environmental footprints in terms of inputs.

SSLF, food security and CC

As regards the capacity of SSLF at producing animal source foods for a growing population, the first that needs to be considered is whether this situation really requires of an increase in animal production or not. In fact, some authors suggest that the present increase in animal source food production is not demand- but supply-driven, triggered by a combination of supply increments, fostered by multilateral organizations in developing countries, and favored by the externalization of environmental and social costs, which in the end influences both product prices and consumer habits. In addition, this supply-driven increase in livestock production is causing health, environmental, and social problems, and it also reduces empowerment of both producers and consumers. Accordingly, a growing number of authors claim the need to reduce the amount of meat consumed, particularly in rich countries. A redistribution of livestock consumption from food surplus to food deficit regions would have coupled human health and environmental benefits.

Once stated that the projected increased production of animal source food may be based on wrong assumptions (demand-driven), and that it may not be desirable from a human health perspective, not from an ecosystem and social health perspective, the capacity of SSLF systems to feed the world can be discussed. It is clear the need to integrate the food security issue into a wider framework, which also addresses interactions among food security and other social and environmental drivers and outcomes.

In that manner, satisfying the future world demand on animal source food by further utilization of land, fossil fuel, water, etc., that is, by further accelerating the shift from SSLF to LSLF that has already characterized the livestock revolution in the last decades, seems no longer feasible or desirable. Additionally, greater expansion of LSLF could reduce the amount of human-edible food since it is using food crops to feed livestock. The same applies for water, considering that LSLF requires almost five times more water to produce the same amount of edible animal source food, and that the proportion of people living in water-stressed regions grows more and more.

Nowadays the livestock sector, if willing to guarantee the animal source food security in the current situation of both lack of natural resources and demographic growth, in a context of increased climate variability, must shift its focus from increasing production to enhancing resilience. Clearly, this is not always contradictory to increase production when required, as far as resilience is the primary focus. Accordingly, it seems that a major shift towards SSLF systems, and a reduction in meat consumption in rich countries, could represent a major contribution to counteract the current high world food insecurity in the present conditions.

As observed in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica, SSLF communities are extremely efficient at producing animal source foods, thanks to their enormous ability to take advantage of human-inedible forage and marginal lands, to produce high-quality and human-edible foods; to preserve socio-ecological balances that avoid depletion of natural resources and social arrangements; and to promote diets of moderate meat consumption.

Differences among the different categories of livestock farming

Relevant to the debate of livestock, CC and food security, the differences among the three categories of livestock farming, as they move from SSLF and MSLF to LSLF, can be grouped into five:

(i) Increased treatment of livestock farming as an industry.

Particularly LSLF, and to a less extent MSLF, imposes the industrial forms of production to livestock farming – mechanization, intensification, use of agrochemicals, monoculture, feedlots, etc. Among others, this entails the concentration of production in LSLF operations to meet a largely concentrated bulk of consumers in cities buying in supermarkets. Consequently, this system is highly dependent on transport. The present global food system, based on LSLF, is characterized by a high dependence on fossil fuels, with particularly devastating effects on GHG emissions. Livestock production, through its shift from SSLF to LSLF, is being transformed from an activity that generated energy into an energy-consuming activity.

LSLF has become heavily dependent on farmers' continuous investment in energy-intensive machinery and fossil-fuel-based inputs. This dependence is so high that in industrial farming yield gains correlate perfectly with input increases. Grain-fed beef requires 35 calories for every calorie of beef produced. Thus, the livestock revolution expanding LSLF in developing countries can be perceived as a major climate threat. The gradual separation of livestock farming from grasslands, as we move from SSLF to MSLF and finally to LSLF, goes in line with a decreasing importance of ruminant livestock species which often entails the degradation of carbon-rich grassland with a high potential for carbon sequestration, or their conversion into croplands (and correspondent GHG emissions).

(ii) Increasing monofunctional role of livestock farming.

Livestock for small livestock keepers, and particularly pastoralists, represent more than just a source of food or and economic asset. For SSLF communities livestock provides fiber, social status, draught power, manure, recycling residues, cultural identity, keeping savings, etc., all having importance in food security and maintenance of livelihoods. For instance, throughout the Horn of Africa, pastoralists define their wealth and poverty in terms of their ownership of livestock. Thus, it is not strange to picture the shift from traditional SSLF and MSLF towards LSLF as a process of substitution of multifunctional livestock production to commodity-specific livestock production. The highly multifunctional role that livestock plays in SSLF societies, in opposition to what happens in LSLF systems, is well reflected on the fact that approximately 80% of the value of livestock in low-input developing-country systems can be attributed to non-market roles, while only 20% is attributable to direct production outputs; whereas, by contrast, over 90% of the value of livestock in high-input industrialized-country production systems is attributable to the latter.

(iii) Increasing separation between livestock and agriculture.

Every ton of additional humus in the soil relieves the atmosphere from 1.8 tons of CO_2. This points to the crucial necessity of integrating agriculture with livestock farming, and the great difficulty of landless industrial livestock production in mitigating GHG emissions. LSLF, by promoting a separation from agriculture, hinders natural processes in the soil, what leads to the storage of CO_2 as organic matter, and replaces them by 'artificial' processes, based on chemical fertilizers. As a result of the disconnection between agriculture and livestock, the agriculture to feed the animals is conducted far from where animals are, while the nutrients they produce in the form of nitrogen or phosphorus become pollutants. At the same time, agricultural systems suffer from nutrients deficit, which must be compensated with inorganic fertilizers, which in turn, are also important contaminants and produce GHG emissions. It is estimated that the total amount of nutrients in livestock excreta is as large as the total amount of nutrients contained in all chemical fertilizer used annually. Furthermore, manure performs better than artificial fertilizer for soil structure and long-term fertility.

The LSLF's dependence on chemical fertilizers, intensive animal production, through the related agricultural production of monocultures for feed production, generates enormous quantities of NO_2. A big share - often above 50% - of the energy use in farming is for the production of synthetic fertilizers, in particular nitrogen fertilizers, and pesticides. In the last 50 years, the great use of chemical fertilizers and other unsustainable practices of industrial agriculture have triggered an average loss of between 30 and 60 tons of soil organic matter for every hectare of agricultural land. Some authors point that rebuilding soil fertility to pre-industrial levels would capture 30-40% of current excess of CO_2 in the atmosphere.

Animals are inefficient nitrogen users. This is particularly the case for ruminants. Nonetheless, when ruminants are fed roughage - like grass or bran - and their excreta returns to soils - as in SSLF and to less extend in MSLF - their nitrogen inefficiency has no remarkable negative impacts as regards GHG emissions. Likewise, the manure deposited on fields and pastures does not produce significant amounts of methane, while factory farms and feedlots that manage manure in liquid form release 18 million tons of methane annually.

(iv) Decreasing capacity of valorizing marginal lands and products.

Another major difference between SSLF, MSLF and LSLF, is that while the latter and grain-fed MSLF compete directly with human beings for food; SSLF valorizes crop residues, human-inedible forage and marginal lands that could hardly be devoted to other purposes. It is evident that livestock keeping can contribute to further lowering GHG emissions by further using as feed roughage and nutrient rich residues from farms and households, and by reducing the amount of grain cultivated on high-input systems.

Livestock farming makes its most important contribution to food security when it is conducted in environments where crops cannot be grown easily, such as rangelands in case of pastoralism and ranching, and when livestock scavenges on public land or is fed on crop residues, using feed sources that cannot directly be eaten by humans. In this way, SSLF makes notable contributions to the balance of energy and protein available for human consumption. LSLF, however, converts high-quality carbohydrates and proteins, which might otherwise be eaten directly by humans, into a smaller quantity of higher-quality energy and proteins. In this latter case, livestock farming is clearly increasing food insecurity and natural resources depletion. It is clear that reducing the amount of human-edible food required to produce the livestock feed would be a valuable contribution to food security, as well as to CC mitigation.

(v) Increasing reduction of diversity at all levels.

Biodiversity is a source of genetic diversity, which might be extremely useful to develop resilience in the livestock sector to the new stresses that can turn up in the future, by facilitating new adaptation strategies and production options. Linkages between biodiversity and livestock production systems are two-fold. Livestock-keeping communities promote and preserve biodiversity through maintaining marginal lands, which are important reserves of biodiversity, and promoting an enormous variety of livestock species and breeds, which are used in a great number of farming practices.

The promotion and preservation of biodiversity, both wild and domesticated, is an essential difference between SSLF and MSLF, and LSLF. Biodiversity preservation is fundamental to guarantee the sustainability of SSLF systems and their adaptation to upcoming changes. On the contrary, LSLF uses mostly three species - pigs, poultry, cattle - and very few breeds within these species - high-yielding breeds fundamentally. The breeds and lines selected for high-output production need standardized feed, intensive veterinary treatment and a controlled environment to prevent infections. These breeds have been selected for high-output and good-feed conversion ratios under high-external input conditions. Resistance to diseases and pests, heat and water stress, vitality, fertility and mothering abilities are largely dismissed attributes. In addition, the high densities of animals with low immune systems found in LSLF easily ends up in the emergence of more diseases. This situation makes LSLF very vulnerable to climate variability, due to its extremely low capacity to adapt to changes. In contrast, SSLF systems breed and nurture 40 livestock species and almost 8,000 breeds. However, the expansion of LSFS together with the rejection of SSLF is favoring the disappearance of many local breeds, and thus limiting the capacity of the livestock sector to adapt to present and future climate variability.

Measuring GHG emissions

How the concept of productivity is understood is crucial to evaluate the amount of GHG emissions generated by different categories of livestock farming. In fact, the underlying notion of productivity needs revision. It cannot be any longer the unique criterion used to measure GHG emissions the amount of meat produced, the number of eggs a hen lays per year or the liters of milk produced per day. This is in fact linked to a narrow consideration of the food security concept. It should be clarified that productivity is relative to what is measured and how, and in the CC debate, GHG emissions must relate to the climate impact of the whole product life cycle, including feed footprint. The measurement most conventionally used to determine GHG emissions relates the volume of CO2 emitted per mass of livestock product obtained, but other possible ways of measuring productivity exist.

Indeed, the use of different metrics favors different livestock types or systems. For example, given that extensively-reared animals produce less edible output per unit of GHGs emitted than their intensively-reared counterparts, when the measurement employed relates emissions with the quantity of livestock product obtained, LSLF is favored. However, when a resource-sensitive measurement is used, intensively-reared animals show larger emissions per unit of resources used than pastoralism, ranching, backyard pig and poultry production, and small mixed farming. Thus, productivity from extensive grazing systems is high in terms of output from limited resources. Pastoral systems are found to be more productive per unit area due to the ability of pastoralists to move their herds opportunistically and take advantage of seasonally available pastures. Omissions are also related to the value of the informal economy and the subsistence function of SSLF, and the value of maintaining the health of ecosystems and other land uses.

Livestock and mitigation strategies

The mitigation potential of the SSLF systems, as observed in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica, is enormous. It mainly consists of guaranteeing the maintenance of carbon-rich grasslands and soil fertility, utilization of close markets and little dependence on chemical inputs, and undertaking of carbon-smart diets.

In global terms, several strategies have been implemented in livestock farming with the objective of mitigating its GHG emissions: (i) mitigation through market mechanisms; (ii) mitigation through technological and managerial schemes; and (iii) mitigation through behavioral modification. In general it can be said that while SSLF tend to be related with strategies of mitigation through behavioral modifications, and MSLF with strategies of mitigation via technological and managerial schemes, LSLF generally goes with strategies of mitigation that use market mechanisms. Yet, each group of strategy has its own drawbacks.

(i) Mitigation through market mechanisms
Mitigation strategies based on market mechanism are not affecting SSLF communities positively, and are mostly thought to be implemented by LSLF operations. These communities have mainly access to informal and local markets, consequently are excluded from participating in low-carbon labeling schemes. SSLF communities are also excluded from GHG emission trading systems by the high transaction costs they entail. These mitigation strategies imply the privatization of carbon, allowing the distribution of 'rights to emit' and the trading of these rights. The underlying carbon-offsetting principle is fundamentally flawed since it hampers improvements in emissions' reduction.

(ii) Mitigation through technological and managerial schemes
Although SSLF undertake quite a lot of management practices of high CC mitigation potential, such as moderate grazing, soil conservation, and use of local resources; most technological mitigation strategies being developed tend to be thought for LSLF operations, such as application of biochar, or technologies to reduce production of enteric CH4 and N2O through animal breeding or optimizing the balance between the content of carbohydrate and protein in the feed. The production of biogas from manure can also be implemented by small livestock keepers. However, it entails the risk of favoring livestock corralling and intensifying the current lack of manure for soil conservation and GHG sequestration. Most of the technological mitigation strategies tend to suffer from too much narrow approach to the problem of GHG emissions by livestock farming. An excessive focus on GHGs sequestration offers a reductionist mitigation 'solutions', with no real impact and that distract from the real challenge: reversing the fossil fuel dependence and changing the consumption patterns it induces, and restoring soil fertility.

(iii) Mitigation through behavioral modification
Mitigation through enhancing 'climate-smart diets' offers good opportunities for boosting the role of SSLF in CC mitigation, by favoring local consumption, organic production, and moderate meat consumption. However, research into how changes in behavior can be achieved is still at its infancy compared to the profusion of works tackling technological solutions for GHG mitigation. This imbalance reflects the low priority that policy makers place on behavioral change as an approach to GHG mitigation.

Adaptation strategies of SSLF communities to climate variability

The main CC-related hazards that affect small-scale livestock farming systems, and to which they need to develop adaptation strategies are: increased temperature, changes in seasonal rainfall patterns and more erratic rainfall, higher prevalence of weather extreme events, and higher atmospheric concentrations of CO2. Specifically, in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica, high prevalence of droughts with occasional flooding, and increasing calendar unpredictability, have been the CC-related hazards identified in all four cases.

The adaptation potential of the SSLF systems to climate-related hazards, as observed in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica, is remarkable. SSLF is a group of livestock production systems developed to guarantee the livelihood of societies living in climate margins, namely mountains, cold regions, and drylands. Their knowledge, institutions and customary practices, highly adapted to the local conditions and developed throughout centuries of coevolution with changing environments, can be of a great value to adapt the whole livestock sector to the current situation of increased climate variability.

SSLF communities implement their own adaptation strategies centered on (i) enhancing mobility, what entails moving herds to areas with better grazing and water conditions and securing access to critical resources during difficult times; (ii) boosting social collaboration and reciprocity, what implies adopting strategies such as food sharing, livestock loans, joint ventures, friendly collaboration, communal planning, communal ownership, splitting the herd among different members of the family, communal grazing, and labor exchange, what strengthens the sense of belonging to a commonality and increases the resilience of the community to future changes by fostering mutual support and exchange of knowledge and capacities; (iii) favoring diversification and multi-purpose strategies, as a precautionary strategy to diminish the risk of losses in front of the upcoming of possible unexpected changes; or (iv) preserving and promoting biodiversity, both wild and domesticated, including shifting towards other types of livestock more adapted to the approaching socio-ecological conditions, such as browsers –camels, goats - or short-cycle animals – poultry, pigs, dairy cows. The cost-effectiveness of these autonomous adaptation strategies, and the fact that most of them are of an anticipatory and endogenous nature, show that much can be learned from the adaptation strategies that SSLF communities undertake. Other adaptation measures undertaken by these communities are planned and promoted by external institutions. These include (v) empowering the community members by offering them services and training, such as schooling, health care, and pastoralist field schools; and finally (vi) offering to these communities schemes of sedentarization, food relief and improved market access, to try to improve their livelihoods. In this case they are both anticipatory and reactive. Other strategies can be autonomous or planned, depending on the contexts, such as (vii) adoption of fodder crops and pasture enclosures, what in some occasions also implies livestock corralling, to guarantee more stable feeding conditions for the livestock.

Adaptation to climate variability is a process that never ends. Since vulnerabilities and impacts are permanently evolving, this entails that some forms of adaptation that may be appropriate now, may not be so in the future. Furthermore, we might find that socio-institutional innovations, although being less spectacular – and less expensive in monetary terms - may strengthen resilience further than other technical innovations. However, it is not less true that not all autonomous innovations end up enhancing community's resilience. While autonomous innovations by SSLF should not be romanticized, top-down interventions should always be critically assessed.

Socio-economic drivers intensifying CC's impacts on SSLF communities

As seen in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica, SSLF communities are highly effective in CC mitigation and adaptation, while guaranteeing animal source food security. However, as identified in all four cases, to guarantee the endurance of SSLF and its related benefits, there is the imperious need of overcoming a set of socio-economic drivers, which impede the development and promotion of this category of livestock farming: (i) demographic growth, (ii) neglect of SSLF knowledge, customary practices, and institutions in policy-making, and (iii) increasing integration of SSLF societies within the market economy.

These drivers are impelling gradual dismissal of local traditional knowledge, abandonment of communal planning and institutions, increase in social differentiation, and overexploitation of the limited resources of rangelands. Also rising tensions, both within the community and among communities, and growing levels of malnutrition, are being identified in Turkana, Alaotra Lake region, Khar-o-Touran, and Huancavelica.

Recommendations

These drivers are critically damaging the great capacity of SSLF in enhancing GHG sequestration, CC-related hazard adaptation, and animal source food security. To counteract these damaging trends, a set of recommendations are briefly deployed as follows:

- In Turkana it is particularly imperative interceding to diminish the violence among neighboring pastoral communities, and modifying the humanitarian aid towards more restocking and training to pastoralists instead of food relief.
- In Alaotra Lake region it is particularly imperative interceding to diminish livestock raids, control grassland fires, and preventing further soil erosion and favoring soil preservation measures.
- In Khar-o-Touran it is particularly imperative interceding to diminish the violence among pastoralists and settled farmers, and providing more control of the natural resources to pastoralists.
- In Huancavelica it is particularly imperative interceding to reduce the violence among neighboring pastoral communities, and favoring of grassland degradation prevention measures and grasslands restoration measures.