Animal production vision and strategy for Ethiopia

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ETHIOPIA LIVESTOCK MASTER PLAN BACKGROUND PAPER

Animal production vision and strategy for Ethiopia

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Preface

In 2012, the Ministry of Agriculture commissioned ILRI to develop several background papers to inform the development of a livestock master plan and roadmap for Ethiopia. The papers were developed by teams of people brought together for this task.

The production of the background papers was supported by the Improving the Productivity and Market Success of Ethiopian farmers project (IPMS) funded by the Canadian International Development Agency (CIDA). The eight papers are listed below and are all available at https://cgspace.cgiar.org/handle/10568/51565.

- Animal health strategy and vision for Ethiopia.
- Animal production vision and strateghy for Ethiopia.
- Apiculture value chain vision and strategy for Ethiopia.
- Dairy value chain vision and strategy for Ethiopia
- Livestock extension vision and strategy for Ethiopia.
- Hides, skins and leather value chain vision and strategy for Ethiopia.
- Live animals and meat value chain vision and strategy for Ethiopia.
- Review of past policies and strategies for livestock in Ethiopia.

Background: The animal production subsector

Livestock play a crucial economic role in Ethiopia. MOFED estimates place livestock's contribution at about 25% of total agricultural GDP. If the value of ploughing services is included, the sector contributes up to 45% of agricultural GDP (http://www.igad-lpi.org/publication). Almost the entire rural population in the highlands and lowlands is involved in some form of animal production, which provides food, cash, traction, transportation and fuel. In lowland pastoral and agropastoral areas, livestock form the main source of livelihood and social prestige. The country has enormous potential for increased livestock production, both for local use and for export. However, the productivity of the sector is constrained by technical factors, among which are inadequate feed resources, poor livestock husbandry, and low genetic potential of the indigenous national herd. Lack of strong extension and marketing services, as well as an encouraging policy environment are also serious constraints.

Cattle in Ethiopia are almost entirely of the zebu type and are poor yielders of milk and meat. However, they perform relatively well under the prevailing traditional low input husbandry systems. Meat and milk yields are low and losses high; and diseases and parasitic infections that are exacerbated by malnutrition and starvation are major causes of mortality.

Most of Ethiopia's estimated 45 million sheep and goats are raised by smallholder farmers/pastoralists who use them for meat and cash income. About three-quarters of the total sheep flock is in the highlands, whereas pastoralists in the lowland maintain about three-quarters of the goat herd. Sheep and goats have high sales value in urban centres, particularly during holidays and are highly demanded by export abattoirs. Camels provide pastoralists/agropastoralists with milk and meat and play a key role as pack animals. Poultry farming is widely practised; almost every family keeps some poultry for consumption and for cash. Village poultry farms supply eggs and meat mainly to urban consumers. Private poultry farms using intensive management systems are now increasing in number. While efforts are being made to commercialize the Ethiopian livestock sector, questions still arise as to how Ethiopia can develop and expand this sector.

Current situation

To ensure higher levels of animal production, an ecologically differentiated approach is being followed as outlined in the Growth and Transformation Plan (GTP) of Ethiopia (MoFED 2010). Targets were set for key commodities like feed, milk, meat, and egg and honey production. Targets for the feed subsector are to increase improved forage seed supply from 50 thousand quintals at present to 145 thousand quintals at the end of the plan period; to increase processed feed production from 50 thousand quintals at present to 145 thousand quintals at the end of the plan period. Similarly, the amount of meat production is planned to increase from 613 thousand tonnes in 2010 to 836 thousand tonnes at the end of the GTP period. Regarding milk production, it is planned to increase milk production from 3261 tonnes at present to 11,176 thousand tonnes at the end of the plan period. In the same manner, egg production is planned to increase from 79.1 million to 294 million. In addition, production of skins and hides is planned to reach 10.2 million tonnes from the present 4.1 million tonnes, whereas honey production to increase from 44.7 thousand tonnes in 2010 to 103 thousand tonnes in the year 2015.

It is only for few commodities that official information on the current progress of the planned targets is available. A report by CSA (2010/11) indicated that the total production of cow milk is about 4.06 billion litres, suggesting the average daily milk production/cow to be 1.86 litres. This makes the total milk produced to be about 4,057,998,244 litres for the year. As regards meat production, it was reported that about 463,918 cattle were used for beef. Total sheep used for mutton during the stated year was 706,745. In the same year, about 781,371 goats were used for meat. It is thus logical to conclude that the rate of progress is low indicating the importance of further increasing the efforts made to achieve the set targets.

Vision and targets

Vision

Smallholder farmers and pastoralists will have their food security ensured and produce a surplus for the market; commercial livestock operators produce livestock products for both domestic and export markets.

Targets to 2025

In setting these targets, it was assumed that most of the set targets will not be met during the remaining 2 years of the GTP years and they will require an additional 10 years to achieve.

- To reduce the livestock feed gap from the present 45% to 10% (own calculation based on feed and livestock statistics).
- To increase processed feed production from 50,000 quintals at present to 145,000 quintals/year (MoFED 2010).
- To increase forage seed production from 50,000 quintals at present to 150,000 quintals/year (MoFED 2010).
- Increase milk from local cows to an average of 4 litres/day and from crossbred cows from 6 litres per day to about 15 litres/day per cow through better husbandry practices (MoFED 2010).
- The number of chickens for slaughter is targeted to increase from 10.1 million to 22 million in 2015 (MoFED 2010). This can be achieved by 2025.
- Increase the amount of meat production from 613 thousand tonnes to 836 thousand tonnes (MoFED 2010). This can be achieved by 2025.

Challenges and strategies for highland systems

This section describes strategic options for improving animal feeds and nutrition, livestock husbandry, and animal breeding under highland systems. Priority areas for livestock research within the context of integrated crop and livestock production are also outlined.

Challenge 1: Shortage of feed resources

Feed shortage in both quality and quantity is a major constraint affecting animal production in the highland areas. Options for improving animal feed resources (both roughage and processed) feeds is outlined hereunder.

Shortage of roughage feeds: Roughages for livestock are obtained from native pastures, crop residues, agro-industrial by-products and improved forages. The following options are suggested for improving availability of roughage feeds.

- Strategic options

    - At smallholder level, greater attention needs to be given to improved forage production by using available forage technologies; for native pastures, over sowing with improved grass and legume species, and bush clearing from grazing fields is recommended. Use of improved forage varieties with their management techniques, and enhancement of the quality of crop residues using urea and urea–molasses mixture treatment needs to be considered. To achieve this, practical training needs to be given in the form of training of trainers to be given to DAs by the Regional Bureaus of Agriculture in collaboration with potential stakeholders at both federal and regional levels.

    - Shortage of forage seed is an important constraint to improved forage production. It is thus important to improve supply of forage seed by making land and credit services available to private seed producers. It is also important to strengthen the technical and material capacity of government agencies (regional and federal seed enterprises, and research centres) for forage seed production. Regional and federal investment agencies can play a key role in facilitating investment initiatives for forage seed production, while research institutes at regional and federal levels and the MoA will be the main actors in capacity building support to research centres and seed enterprises.

    - The federal and regional investment agencies need to avail land that is fertile, irrigable, and close to market destinations, to private investors interested in feed production (mainly hay) to ensure sufficient feed supply for the emerging market-oriented livestock operations (example, feedlots and peri-urban dairy).

Shortage of processed feeds: Feed is the major constraint to improving productivity and overall livestock production, and processed feeds form essential components of the feed available on-farm in improved production systems. Market opportunities for processed feed are opening up due to the increasing trend of commercial livestock operations, smallholder and large-scale dairy, meat fattening and poultry. The problems facing the feed processing industries are

multifaceted and require commensurate solutions by the value chain actors involved. To improve the situation, the following interventions are proposed:

- Strategic options

    - To increase production of quality feed in large-scale commercial operations, consider government investment policy to make large plots of land and credit available to investors at concessional rates for investments in animal feed production and processing.

    - To ensure the quality of processed feed, it is important to put the new Ethiopian feed proclamation into effect; and institute accreditation of analytical service laboratories to ensure quality feed production. This can be facilitated by organizing forums for dialogue at which concerned stakeholders/policymakers will participate. In this case, professional societies like ESAP, Ethiopian Animal Feed Producers' Association (EAFPA) and the Ethiopian Meat and Dairy Technology Institute (EMDTI) can play facilitation roles.

    - It is essential to increase availability of by-products of oil industries that are used as inputs in feed processing industries by processing them locally rather than exporting them unprocessed. Hence, the government needs to promote oil extraction and flour milling factories so that more by-products are made available.

    - Promote private sector participation in large-scale production of soybean and maize to ensure sustained supply of these key ingredients available as inputs for feed processing. This can be achieved through facilitating land availability by regional and federal investment agencies.

    - Increase the level of awareness of policymakers on the critical importance of livestock feed through organizing dialogue forums in which concerned decision-makers participate. In this regard, professional and industry associations and the Ethiopian Meat and Dairy Technology Institute (EMDTI) can play a leading role.

    - Training visits to other countries whose feed processing industry experience can be taken as a benchmark for developing efficient feed processing industries at home. This type of visits can be facilitated by stakeholders (private investors, GOs and NGOs) involved in feed and livestock development programs.

    - Change GOE tax policy to avoid double taxation and/or consider periodic tax exemption for feed ingredients and compound feeds to give an initial push to the industry takeoff through increased private investment.

Minimize seasonal fluctuations in ingredients and compound feed prices and ensure sustainable feed production through advising feed processors to develop their storage capacity for processed feeds and the ingredients required to produce these feeds. This can be undertaken by relevant stakeholders (regional bureaus of agriculture, livestock development agencies, MOA, Ministry of Trade, and NGOs like ACDI/VOCA). This can be done through awareness creation meetings in which the industry owners will participate.

Challenge 2: Poor husbandry systems for meat and milk animals

In Ethiopia, average meat yield/animal is estimated to be 110 kg of beef and 10 kg of mutton. Evidence indicates that mean milk production performance of cows is around 1.5 litres/cow per day over a lactation period of about 6 months, resulting in 270 litres/lactation. Milk production is not keeping pace with population growth, leading to declining per capita milk consumption. Average per capita consumption of milk and meat is estimated to be 16 and 10 kg, respectively (Adugna et al. 2012). These figures, which are among the lowest in the world, are clear evidence of the very low productive performance of the livestock sector which is due to poor livestock husbandry systems (Alemu et al. 2012).

- Strategic options for improving meat animal husbandry (cattle, sheep and goats)

    - Strengthen the capacity of smallholders through training on important topics like animal husbandry, forage production and management, crop residue treatment and utilization and cattle fattening practices. This can be done at Farmers' Training Centres by DAs, SMSs and other potential collaborating institutions (GOs and NGOs) working in the areas of livestock development.

    - Fragmented farmers/producers lack bargaining power and it is therefore important to organize livestock producers as aggregators and traders, in share companies, or trade cooperatives. This can be facilitated by the joint action of regional livestock development agencies, research institutes, cooperative promotion offices, and small and micro-enterprise (SME) development agencies.

    - Support private feedlot operators having their own demonstration and extension systems for surrounding producers, and input supply and service oriented businesses. These types of feedlots can play vital roles in supply push (example, catalysing feed production and converting animals to better condition to produce quality products) and demand pull (example, creating demand for animals, benefitting the surrounding producers). This can be done through enhancing tripartite partnerships between the feedlot owners, public research and extension services, and producers (PPP), through both formal and informal linkage mechanisms. The formal linkages between the various actors can be bound by a memorandum of understanding and the responsibilities of the parties involved can be jointly defined, agreed upon and endorsed at the stakeholders' workshop. This type of partnership can be facilitated by a joint committee nominated to supervise the overall functioning of the linkage framework. This is the type of model which is being used by Eden Field Agri-seed Enterprise and by some private investors involved in tea production and processing.

- Strategic options for improving milk animal husbandry (cattle)

    - As in the case of meat, the husbandry skill of producers needs to be strengthened through training on important topics like dairy herd management, forage production, crop residue treatment and utilization, milk handling and clean milk production procedures. This can be done at farmers' training centres by DAs, SMS and other collaborating institutions like EMDTI working in the areas of dairy development.

    - Government needs to support investment initiatives in improved dairy production, processing and marketing either by cooperatives or private investors in the sector. In this regard, suitable land in high potential dairy areas has to be identified and made available by concerned agencies (example, investment promotion agencies at federal and regional levels).

    - It is very critical that GoE support private animal health service initiatives by offering credit and business management training to veterinary professionals interested to set up private businesses. It is also essential to put into effect the drug and feed administration proclamation for controlling illegal drug and health service providers through establishing the authority planned to be established.

Challenge 3: Low genetic potential of indigenous animals

- Strategic option: Match genotype with the suitability of production environment and taste preferences

The interaction between animal genotype and suitability of production environment is critical for sustainable productivity improvement. Scaling up of 50:50 (indigenous by exotic) blood level is advisable for smallholder systems with intensive management system. In situations where herd management is very ideal, be it under smallholder or large-scale commercial production systems, it is advisable to upgrade exotic blood levels to 62%. Piloting of crossbred goats and sheep can be carried out and scaled up, but it is not the highest priority due to strong taste preferences for local breeds in both export and domestic markets. Needed breed improvement interventions include:

- Production and distribution of crossbred cows of 50% Holstein or Jersey blood to smallholder farmers by strengthening public and private sector AI services, bull services, existing cattle crossbreeding ranches and regional and federal research centres.

- Depending on the status of prevailing husbandry systems, upgrade crossbred cows to 62.5% exotic blood level for market-oriented peri-urban farmers with better management systems.

- Strengthen the skill of smallholder dairy farmers, DAs and SMSs on dairy animal husbandry (feeding, health, and housing) and on how to improve the reproductive efficiency of dairy cattle (AI technique, synchronization/ induction of oestrus) is crucial. This training activity can be undertaken by EMDTI, National Artificial Insemination Centre (NAIC), regional and federal research centres and ATVETCs.

- Improve the body condition (energy balance) of dairy animals through increasing feed availability by availing seed and other associated inputs for forage production, and improved crop residue management and utilization. This can be strengthened by continuous training and technical support and supervision provided by DAs and SMSs at district level.

- For improving meat production, it is advisable to improve the indigenous breeds of cattle like Boran, Horro and Ogaden breeds through selection. The same will also be true for other indigenous species like sheep, goats and camels.

- Strategic option: Improve the efficiency and effectiveness of public AI services

Unavailability and inefficient use of artificial insemination (AI) for crossbreeding indigenous cattle with exotic breeds is common in Ethiopia (G/Medhin 2008). The reported number of crossbred animals is proportionally very low, about 350,000 (Belachew Hurissa, personal communication). Although artificial insemination has been in operation in Ethiopia for over 30 years, and the efficiency and impact has not been well documented, available evidence indicates that reproductive and productive problems are pervasive (Chebo and Alemayehu 2011). Options to improve AI technology and services include:

- It is critical that GoE promote private AI service providers and animal health businesses through facilitating credit and business management training activities. This effort can be supported by important stakeholders like investment promotion agencies, and SME development agencies.

- Increase the number and service quality of public inseminators through training (theoretical and practical) by strengthening the capacity of available ATVETs graduating these experts and improving the curriculum. In this regard, it is advisable for public sector AI services to focus on rural smallholder dairy systems and the private sector to focus on AI activities around peri-urban areas.

- GoE to strengthen the capacity of the National Artificial Insemination Centre (NAIC) through financial

support for upgrading the facility and human resources, and filling technical capacity gaps to improve the quality and quantity of semen produced and distributed. The private sector can also participate by importing sexed semen to sell to dairy farmers that are willing to pay. Regional AI centres need to also be strengthened by the regional bureaus of agriculture and livestock development agencies. In the process of strengthening the regional centres, the NAIC is expected to play a research and quality assurance role.

- As efficiency of AI is determined by body condition (net energy balance), it is important to improve feeding systems of animals undergoing AI, using strategies mentioned under the animal feed and nutrition section above.

Challenge 4: Poultry production

Poultry is an important source of food and income in Ethiopia and is one of the most suitable sectors to improve the livelihoods of the poor. Production of a small number of low yielding local chickens is the major poultry production system and this contributes to more than 90% of total national output of poultry meat and eggs. It is characterized by a flock size of 5–6 per family (EARO 2000c). Production under this setting is usually targeted for home consumption and there is almost no attempt to increase the scale to a commercial level. There are also emerging commercial poultry farms with varying flock sizes owned by individual investors and currently a fast trend of expansion of these commercial ventures is being observed. Dana et al. (2006) indicated that the long existed approach used by the MoA to improve village poultry has been to distribute exotic breeds to individual farmers, a maximum of 6 chickens/household (5 pullets and 1 cockerel). Despite such efforts, improvement has been limited mainly due to the high mortality rate of exotic breeds as a result of their poor adaptation to rural conditions. Two key strategic directions are thus proposed here for implementation to improve the poultry sector.

Transforming village poultry production into viable commercial ventures near urban areas through piloting the use of a comprehensive package of suitable technologies, establishing access to credit and links to input–output markets, and providing training and technical backup under a multi-institutional framework: This piloting activity can be done in two phases; the planning phase and implementation phase (Dana et al. 2006). While the planning phase is a preparatory phase, implementation phase activities include construction of poultry houses, hay box brooders and equipment (feeding and watering troughs), delivery of selected package of technologies (breed, feed, vaccine, drugs and chemicals, equipments, management and health care practices), monitoring and evaluation, design and formulation of an exit strategy in a participatory manner with farmers and FTC staff, and sustain scaling up/out activities.

Strengthening emerging private commercial poultry farms through institutional support (availing land, credit, market facilitation) and technical support (identification of suitable farm sites, availing information on appropriate breed, and husbandry practices (feed, water, housing, health). This can be facilitated by MoA, regional bureaus of agriculture, and federal and regional investment offices, federal and regional research institutes, regional livestock development agencies.

Challenge 5: Livestock production research gaps in highland systems

- Recommended animal production technologies based on biological response need to be assessed for economic feasibility before embarking on their large-scale dissemination to the farming communities.

- On-farm testing of animal production technologies in a participatory manner with the farming communities is critical to facilitate adoption of available animal production technologies.

- Strategies for conservation and utilization of indigenous livestock species has to be formulated through research;

systematic crossbreeding and selection programs mainly in dairy to enhance cattle milk, and egg and poultry meat needs to be focused by regional, national and international research organizations operating in the country.

- Research on forage seed production needs to be strengthened to develop crop management technologies that contribute to improved forage seed availability by strengthening the capacity of researchers working in the areas of forage and forage seed production.

- Develop alternative livestock feeding strategies based on non-conventional feed resources to alleviate the escalating cost of industrial feeds mainly for smallholder farmers. This is to be undertaken through designing alternative livestock feeding experiments by regional and national research institutions.

- Feeding guidelines for different classes of cattle (calves, cows, heifers) and species (cattle, sheep and goats, camels etc.) needs to be developed through alternative feeding trials by national and regional research staff.

- Research for development of processing technologies for milk and meat needs to be initiated. This can be started through evaluation of existing traditional technologies; select promising traditional systems or modify to improve their efficiency. Another approach can be to introduce processing equipment, test them under local conditions for suitability and promote the promising ones. This can be implemented by regional and national research centres involved in animal production research.

Challenge 6: NRM in mixed production systems of the highlands

- Increasing the linkages between crop and livestock production is an effective means by which plant nutrients can rapidly be recycled between farms and animals. This can be achieved by promoting the use of crop residues for animal feeding and recycling of manure to crop farms as fertilizer. Though farmers in crop–livestock mixed systems of Ethiopia have traditionally been using this strategy for thousands of years, it is important to regularly create awareness on the beneficial role of these principles for the sustainability of their farming systems. This production system sustainability oriented training activities need to be delivered by a team of experts (DAs, SMSs) coming from livestock, crop and natural resource related backgrounds.

- The prevailing demographic and economic dynamics in the country will continue to reinforce the importance of crop residues improvement as animal feeds. Potential options include: increasing on farm availability and quality of crop residues through selection of better multi-purpose varieties and management practices, and improved utilization of crop residues by chemical and physical treatment options as previously suggested. This is achieved through collaborative system oriented research, in which crop, livestock and natural resource researchers participate for developing multipurpose crop varieties with high grain and stover yields, and stover quality.

- It is vital that natural resource management activities be integrated with livestock feed production. Options include growing of forage species in enclosures established for rehabilitating degraded grazing lands, and growing of forage species on degraded lands; and using the herbage biomass obtained from these systems as livestock feed as cut and carry fodder so that a win–win outcome is achieved. As three DAs are stationed per kebele under the current technology transfer systems of Ethiopia (1 each for livestock, crop and natural resource management), these activities can be implemented at kebele level in participation with the local community. The overall support for implementation and sustainability of this strategy has to come from SMSs at district or zonal level.

- Integrating reforestation activities with livestock production through incorporating multipurpose tree species like Leucaena, Sesbania, Tagasaste, and others with the NRM intervention, so their fodder can be used as a protein supplement for livestock subsisting on low quality crop residues. The implementation strategy and the key stakeholders here will be as mentioned above for enclosures.

Challenges and strategies for lowland pastoral and agropastoral systems

Due to the huge livestock population in pastoral/agropastoral regions, the contributions of lowland livestock to the national economy could be much greater. Livestock in lowland pastoralist and agropastoralist systems are not meeting their potential, due to both natural and manmade problems. The challenges, primarily those related to animal production, include shortage of water, poor animal husbandry systems, marketing problems, conflict, rangeland degradation and fragmentation, increasing aridity and the increasing occurrence of recurrent droughts resulting in both feed and water shortages, and consequently poor livestock productivity. Constraints to and strategic options for improving livestock production in lowland pastoralist and agropastoralist systems are suggested as follows.

Challenge 1: Shortage of water

Water is the major constraint in all pastoral/agropastoral regions of the country. Thus pastoral development strategy of the government need to be water-centred and it will not be successful if priority is not given to water development. Water can be made available for livestock and human consumption through river diversion work where rivers are available and through drilling the underground water. This task can be accomplished through development of irrigation schemes and through scaling up of successful experiences (example, that of Borana and Fentale areas) to other pastoral areas. Indeed, the GoE has given emphasis to water resources development in the Growth and Transformation Plan (GTP) which is being implemented currently. In these initiatives, regional water bureaus, Federal Ministry of Water and Energy, disaster prevention and preparedness agencies at all levels need to participate.

Challenge 2: Poor livestock husbandry systems

- Strategic options

    - Strengthen the skill of pastoralists through training on important topics like pastoral animal husbandry, forage production and management under lowland systems, crop residue treatment and utilization and cattle fattening practices. This can be done at pastoralists' training centres by DAs, SMSs and other potential collaborating institutions (GOs and NGOs) working in the areas of livestock development.

    - Fragmented pastoralists lack bargaining power and it is therefore important to organize them as aggregators and traders, in share companies, or trade cooperatives. This can be facilitated by the joint action of regional livestock development agencies, research institutes, cooperative promotion offices, and small and micro-enterprise (SME) development agencies.

    - Support private feedlot operators to establish their farm nearer to pastoral areas to create market opportunities for pastoralists.

- Herd management skill of pastoralists needs to be strengthened through training on important topics like camel/shoats/cattle husbandry, pasture production and management, crop residue improvement and utilization, milk handling and clean milk production procedures. This can be done at pastoralists' training centres by DAs, SMS and other stakeholders working in the area.

It is very critical that GoE support private (mobile) animal health service initiatives by offering credit and business management training to veterinary professionals interested to set up private businesses in pastoral areas. It is also essential to put into effect the drug and feed administration proclamation already publicized for controlling illegal feed and drug suppliers and animal health service providers through establishing the authority anticipated to be established.

Challenge 3: Poor livestock marketing systems

Lack of markets for livestock is one of the constraints that affect the livelihood of pastoralists. Reports (for example, Mussa 2004) indicated that there is meagre market infrastructure and no satisfactory market mechanisms in the pastoral areas. Government efforts to export livestock are affected by frequent bans imposed by importing countries. It has also been reported that due to lack of market infrastructure in the pastoral areas, the pastoralists sell their animals at the border markets at lower prices to traders from neighbouring countries, which also affects the foreign exchange earnings of the country. To make pastoralists benefit from their livestock, focus has to be given to the establishment of livestock marketing system. The government plan in GTP to put new market infrastructures and strengthening of the existing ones need to be implemented. Efforts has to be made to integrate pastoralists with domestic investors undertaking fattening, abattoirs, and traders, as well as to make them organized in cooperatives in order to solve their marketing problems in an organized way. In addition to these, support has to be rendered for private investors to invest on slaughter houses in pastoral areas, and the government to build quarantines that fulfil the required standards. The activities can be accomplished through various stakeholders like pastoral development commissions, regional livestock development agencies, MoA, Ministry of Federal Affairs and concerned NGOs.

Challenge 4: Conflict resolution

Conflict is another problem in pastoral and agropastoral systems. The major cause of conflict has been reported to be competition over grazing land and watering points. Border conflicts were also reported to affect the livelihood of the pastoralists. An effort has to be made to resolve this issue. In this regard, the Federal Affairs Ministry, The Pastoral Affairs Standing Committee of the Federal Parliament, regional peace and security offices and traditional conflict resolutions institutions need to act in harmony. Governments and customary institutions need to work closer together to identify their respective roles and responsibilities in relation to conflict prevention and resolution, such as land allocation, access to pasture and water resources (Mussa 2004).

Challenge 5: Rangeland degradation and drought mitigation

The strategic approaches outlined under these challenges are more of a set of crosscutting principles rather than specific technological packages because of the complex and overlapping nature of degradation, aridity and drought.

- One option to alleviate land degradation in the lowlands is through the use of better land management practices. These include a number of technological practices like conservation tillage and related conservation agriculture in pastoral and agropastoral farming systems (EARO 2000a; EARO 2000b). This include:

    - Build-up soil organic matter and related biological activities by integrating agroforestry to provide biomass; and the use of compost, farmyard manure, green manures, surface mulch, cover crops and crop residue management (EARO 2000a). This requires an integrated approach in which natural resource, livestock and crop science experts participate.

    - Better animal and crop management by using appropriate varieties of forage and food crops (for example, drought resistant and early maturing), improved crop establishment at the beginning of the rains (to increase protective ground cover, thereby reducing water loss and soil erosion), effective weed control and integrated pest management. Further, optimize the utilization of indigenous livestock breeds that have better disease and stress tolerance, optimize the utilization of adaptable indigenous forage and fodder species (EARO 2000b).

    - Better rainwater management to increase infiltration and eliminate or reduce runoff so as to improve soil moisture conditions within the rooting zone, thereby lessening the risk of moisture stress during dry spells, while reducing erosion. Recommended water management strategies outlined in the government's policy directions (pond construction, terracing and related physical structures) can be employed for this purpose. This can be implemented by pastoralists/agropastoralists through technical support of the DAs and concerned NGO communities.

- The allocation of large tracts of pastoral lands to commercial investors, and government development projects is expected to continue. These activities need to be planned in a manner that protects the access of pastoralists to the key resources they depend upon for livestock production, like dry season grazing sites and water resources (Halderman 2004).

- The government in its GTP has stated voluntary settlement as one of the strategies to improve the livelihood of pastoralists. One justification is that settling the pastoral households is vital for delivering social services by both the government and NGOs. It eases provision of food aid, basic social and infrastructure services such as access roads, clean water supplies, electricity, schools and clinics as well as extension services. But, studies indicate that sedentarization without developing the necessary infrastructure and without consulting the pastoralists will not be acceptable and will not be sustainable (Mussa 2004).

- Though improvements have been made, donor, NGO and government planning for drought is still made on an ad hoc basis and this needs to be re-evaluated and proactive mechanisms need to be developed (Paulino and Wekesa 2008).

- Drought emergency interventions need to recognize the fragility of some of the changing/developing livelihood systems to drought. There should be less emphasis on technical 'hard' interventions and more emphasis on supporting communities through periods of 'shocks', for example during rebuilding or establishing local social support mechanisms and appropriate institutions (Gizachew 2012).

Challenge 6: Production research gaps

Many of the priority research areas outlined for highland systems can also work for lowland areas. However, selected areas of research for pastoral/agropastoral systems mainly focusing on rangeland issues are outlined as follows:

- Strategic options

    - In the past, the process of bush encroachment was studied to some degree. A number of research issues remain that need to be addressed as part of a long-term monitoring plan that will promote better understanding of the mechanisms of bush encroachment in the savannah ecosystems. These include: effects of human settlements; soil seed banks; and competition for soil moisture and soil nutrients affecting the regeneration of invasive woody plants across different landscapes related to grazing pressure.

    - Although some information regarding the historical patterns of vegetation change is available mainly based on pastoralists' perceptions, field based monitoring and continued research is needed to confirm these findings. In this regard, the use of earlier aerial photographs combined with long-term vegetation monitoring might be required to confirm pastoralists' observations of vegetation changes.

- The threat of bush encroachment on the pastoral economy needs further research. Generally, the link between climate change and grazing pressure in driving bush encroachment and the consequences on cattle populations requires long-term investigation. This does require a long term research program in which both national and international research institutes participate.

- The long-term effects and continued monitoring of bush encroachment control methods on the regeneration of invasive woody plants and the restoration of herbaceous plant biodiversity require more research to be better understood.

- Research is needed to demonstrate the different bush encroachment control methods on a small-scale that could be linked to communities' forage reserves to strengthen community education and launch range rehabilitation efforts.

- Livestock product processing (meat, milk etc.) is an important area of research in pastoral systems. This can be put on track through evaluation of existing traditional pastoral product processing technologies; select and use promising traditional systems or modify to improve their efficiency. A further approach can be to introduce processing equipment, test them for suitability under local conditions and promote the promising ones. This can be implemented by regional and national research centres involved in animal production research in pastoral regions of the country.

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