Livestock Water Productivity (LWP) improvement in the mixed crop-livestock system of Ethiopian Highlands, Amhara Region: a gendered sustainable livelihood approach to target LWP interventions for rural poverty reduction

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DEDICATION

This dissertation is dedicated to my beloved families: my husband, Asamnew Abebe, my son, Bisrat Asamnew, my daughter, Fasika Asamnew, and my parents

ABSTRACT

Water is vital for live as such including a wide range of livelihood activities including domestic and productive needs. Access to adequate water supply would significantly contribute to poverty alleviation, whereas lack of sufficient and reliable water will trigger poverty. In mixed crop-livestock systems, livestock is an integral part of the system and a basic asset for rural livelihoods. Water is an essential input for crop and livestock production in these systems. However, water scarcity is the day to day experience of many rural livelihoods, which, among other factors, is caused by mismanagement in livestock keeping, climate change and increasing demand pressure. Therefore, appropriate and targeted intervention in the water sector is of paramount importance to address such problems related to rural poverty and thereby bring about economic, social and environmental improvements. This could be through improving water availability and its use efficiency and integration with livestock management. In this connection, improving Livestock Water Productivity (LWP) through the Multiple Use Service (MUS) approach can considerably contribute such improvements. The study examines LWP from gendered livelihood perspectives in order to fill the social-ecological as well as culturally linked gap of the LWP framework, which in general and up to now mainly reflects the biophysical aspect.

The empirically based study was carried out at two exemplary sites (*Kuhar Michael Kebele* and *Lenche Dima* Watershed) in the Amhara region, Ethiopia. Qualitative and quantitative data were collected between June 2008 and February 2010. A participatory gendered livelihood and poverty analysis was made using the Gendered Sustainable Livelihoods Framework (GSLF on the theoretical side) and PRA as the methodological equivalent. Multiple use technology options were identified and targeted in an effort to suggest better ways to improve productivity, livelihoods with emphasis on women headed households, environmental wellbeing and to ultimately alleviate poverty. The study also explores socio-economic and institutional gaps and solution options. In order to link technological options with socio-economic and institutional interventions, targets for LWP improvement programs are identified and characterized.

The findings of the comparative analysis reflect the common knowledge of necessary targeted approaches and indicate distinct livelihood wellbeing characteristics with respect to poverty status and access to resources. Poor households, especially women-headed households and young farmers' households are found to be a suitable target group for LWP improvement programs. Nonetheless, a number of challenges are identified in relation to the implementation of such programs. Access to and ownership of basic resources like livestock, the capability both in financial as well as technical terms, government and non-government institutions, and last but not least, cultural preferences and perceptions are among the major limitations. On the other hand, absence of appropriate, cost-effective, and labor-saving technologies in relation to water and feed access, improper targeting of participants in livestock and water development programs, poor integration of diversified productive livelihood activities by households, limited awareness of the community with respect to the different services provided by governmental and non-governmental institutions are the other barriers identified in connection with keeping livestock and investing in LWP improvement programs for the poor farmers in general at the community level.

In recognition of the aforementioned challenges and limitations, it is vital for the target groups to have access to multifunctional animals to be watered in sufficient ways. Likewise, intervening in improving awareness, resource access like livestock inputs, technical support for diversified livestock and water-related activities, and improving institutional networks at both local and communal levels are necessary to improve the livelihoods of the poor and marginalized groups. Generally, an integrated and well targeted approach needs to be exercised in order to effectively implement LWP programs and successfully achieve the intended objectives.

KURZFASSUNG

Verbesserung der Wasserproduktivität (LWP) in der Viehhaltung im gemischten Ackerbau-Viehhaltungssystem im äthiopischen Hochland, Amhara Region: ein geschlechtsspezifischer Ansatz zur nachhaltigen Existenzsicherung durch zielgerichtete LWP Maßnahmen zur Armutsminderung.

Wasser ist lebensnotwendig für viele Aktivitäten zur Sicherung der Lebensgrundlage, unter anderem für den Haushalts- und Produktionsbedarf. Der Zugang zu einer ausreichenden Wasserversorgung würde deutlich zur Armutsbekämpfung beitragen; eine nicht ausreichende und unzuverlässige Wasserversorgung kann in vielen Fällen Armut auslösen. In gemischten Ackerbau-Viehhaltungssystemen ist die Viehhaltung ein integraler Bestandteil des Systems und die Lebensgrundlage der ländlichen Bevölkerung. Von gleicher Bedeutung ist Wasser, das ein entscheidender Input für die Produktion in diesem System darstellt. Wasserknappheit ist jedoch charakteristisch für viele ländliche Lebensbedingungen, u.a. verursacht durch schlechtes Viehhaltungsmanagement, auch den Klimawandel sowie zunehmenden Bedarfsdruck im Zuge immer weiter ausgedehnter und weiterer Wasser konsumierender Maßnahmen. Daher sind geeignete und zielgerichtete Maßnahmen von überragender Bedeutung, um die ländliche Armut zu bekämpfen und dadurch wirtschaftliche, soziale und umweltrelevante, das heißt ökologisch nachhaltige Verbesserungen zu erzielen. Dies kann durch Verbesserungen in der Wasserverfügbarkeit und -nutzungseffizienz erreicht werden, die dann in die Viehhaltungssysteme integriert werden. In diesem Zusammenhang kann die Verbesserung der Wasserproduktivität in der Viehhaltung (LWP) durch den Ansatz 'Dienstleistung zur Mehrfachnutzung von Wasser' (Multiple Use Service - MUS) deutlich beitragen. Die Studie untersucht die LWP aus der Genderperspektive, um die sozio-wirtschaftlichen Lücken des LWP-Rahmens, der sich bisher hauptsächlich auf den biophysischen Aspekt bezieht, zu schließen.

Die Studie wurde in zwei Gebieten (in der Gemeinde Kuhar Michael und im Wassereinzugsgebiet Lenche Dima) in Amhara, einer der zentralen Regionen, Äthiopiens, durchgeführt. Qualitative und quantitative Daten wurden zwischen Juni 2008 und Februar 2010 erfasst. Für eine nach Zielgruppen, das heißt Armutsgruppen, differenzierte Analyse unter besonderer Beachtung der von Frauen geführten Haushalte wurden die Instrumente ″Gendered Sustainable Livelihoods Framework″ (GSLF) und Partizipative Erhebung (PRA) eingesetzt. Es wurden Technologieoptionen für eine ´vielschichtige Nutzung von Wasser ermittelt, um Maßnahmen zur Verbesserung der Viehhaltung unter besonderer Berücksichtigung der von Frauen geführten Haushalte unter ökologisch nachhaltigen Bedingungen mit dem Ziel Armutsminderung zu entwickeln. Diese Maßnahmen werden betont an bisherigen Initiativen zur Produktions- wie Lebensverbesserung gespiegelt. Um die technologischen Optionen mit sozial-ökonomischen Interventionen zu verbinden, werden Ziele für LWP-Verbesserungsprogramme analysiert.

Die Ergebnisse der vergleichenden Analyse verdeutlichen einmal mehr, dass es verschiedene Gruppen von Farmerhaushalten gibt, die unterschiedliche Merkmale in Bezug auf ihre Lebensgrundlage (Armutsstatus) aufweisen. Die armen Haushalte, insbesondere die von Frauen geführten, zeigen sich besonders geeignet für Maßnahmen zur Verbesserung der LWP. Jedoch ergeben sich eine der Herausforderungen hinsichtlich der Umsetzung bei dieser Zielgruppe. Der Zugang zu bzw. Besitz von grundlegenden Ressourcen wie Vieh, Interessen der Haushalte, Fähigkeiten finanziell sowie technisch, der Einfluss von Institutionen sowie soziokulturelle Aspekte sind die wichtigsten Einschränkungen. Weitere Hindernisse bei der Umsetzung der Maßnahmen zur LWP-Verbesserung bei den armen Farmern auf der Gemeindeebene sind der Mangel an geeigneten, kosteneffektiven und arbeitssparenden

Technologien für den Zugang zu Wasser und Viehfutter, die ungünstige Auswahl der Teilnehmer in den Förderungs-Programmen (politische Präferenzen), die schlechte Integration diversifizierter Produktionsaktivitäten der Haushalte sowie eingeschränkte Kenntnis auf Seiten der Gemeinden hinsichtlich der verschiedenen Dienstleistungen der Regierungs- bzw. Nicht-Regierungsinstitutionen, und schließlich auch kulturell definierte Präferenzen und Werte bezüglich der Präferenzen im Hinblick auf Tierhaltung.

Unter Berücksichtigung der obengenannten Herausforderungen und Einschränkungen ist es außerordentlich wichtig, den Zugang der Zielgruppen zu multifunktionalen Nutz-Tieren sicherzustellen. Gleichzeitig sind Maßnahmen erforderlich zur Verbesserung von Kenntnissen und Ressourcenzugang wie zum Beispiel verbesserte Tiere, verbessertes Futterangebot etc., technische Unterstützung für diversifizierte viehhaltungs- bzw. wasserbezogene Aktivitäten sowie institutionelle Netzwerke sowohl auf der lokalen als auch der Gemeindeebene, um die Lebensgrundlagen der armen und marginalisierten Bevölkerungsgruppen zu verbessern. Im Allgemeinen ist ein integrierter und zielgerichteter Einsatz erforderlich, um solche Programme effektiv zu implementieren und die Ziele erfolgreich umzusetzen.

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ACRONYMS

ACSI	Amhara Credit and Saving Institution
AI	Artificial Insemination
AMAREW	Amhara Micro-enterprise Development, Agricultural Research, Extension and Watershed Management
ANRS	Amhara National Regional State
ARARI	Amhara Regional Agricultural Research Institute
AREX	Department of Research and Agricultural Extension
BoARD	Bureau of Agricultural and Rural Development
BFALRC	Bahir Dar Fishery and other Aquatic Life Research Center
CBPP	Contagious Bovine Pleuropnuemonia-animals Respiratory Disease
CF	Crude Fiber content of animal feed
CIA	Center of Intelligence Authority
CSA	Central Statistics Authority
CWP	Crop Water Productivity
DAs	Development Agents, working in agricultural office at grassroots level ("*Tabia*")
DFID	Department for International Development
DM	Dry Matter content of animal feed
DWP	Domestic Water Productivity
EARO	Ethiopia Agricultural Research Organization
FAO	Food and Agriculture Organization of the United Nations
FINNIDA	Finnish International Development Agency
FMD	Foot and Mouth Disease, common to cattle
FSDPO	Food Security and Disaster Preparedness Office
GDP	Gross Domestic Product
GSLF/A	Gendered Sustainable Livelihoods Framework/Approach
GOs	Governmental Organizations
ICRISAT	International Crop Research Institute for Semi-Arid Tropics
IDS	Institute of Development Studies
IFAD	International Fund for Agricultural Development
IFPRI	International Food Program Research Institute
IGAD	Inter-Governmental Authority on Development
IISD	International Institute for Sustainable Development
ILRI	International Livestock Research Institute
IPMS	Improving Productivity and Market Success
IPCC	Intergovernmental Panel on Climate Change
IRD	Integrated Rural Development
IWMI	International Water Management Institute
LWP	Livestock Water Productivity
m.a.s.l	meter above sea level
MoARD	Ministry of Agricultural and Rural Development
MUS	Multiple Use System/Service
NAIC	National Artificial Insemination Centre
NGO	Nongovernmental Organizations
ORDA	Organization for Rehabilitation and Development in Amhara

PRA	Participatory Rural Appraisal/Approach
PSNP	Productive Safety Net Program
RRA	Rapid Rural Appraisal
SAERAR	Sustainable Agriculture and Environmental Rehabilitation Commission in Amhara Region
SG	Sasakawa Global
SLF	Sustainable Livelihoods Framework
SSA	Sub-Saharan Africa
TLU	Tropical Livestock Unit (equivalent to 250 kg live weight of animals)
UNDP	United Nation Development Program
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WP	Water Productivity
WoARD	Woreda office of Agricultural and Rural Development

EXTENDED SUMMARY

Access to adequate water supply would significantly contribute to poverty alleviation, as it is vital for a wide range of livelihood activities including domestic and productive needs. Lack of sufficient and reliable water may in some cases trigger poverty. In the mixed crop-livestock system, livestock are an integral part of the system and are a basic asset for rural livelihoods. Water is equally important and is an essential input for crop and livestock production in this system. However, environmental degradation and water scarcity, which among others, are caused by mismanagement in livestock keeping, climate change and increasing demand pressure, are recognized as major problems of many rural livelihoods, especially in the mixed crop-livestock system, where water and livestock development efforts are less integrated. Therefore, appropriate and targeted intervention is of paramount importance to address such problems related to rural poverty and thereby to bring about economic, social and environmental improvements. This could be through improving water availability and its use efficiency and integration with livestock management. In this connection, improving Livestock Water Productivity (LWP) through the Multiple Use Services (MUS) approach can considerably contribute to such improvements. This study, therefore, examines the LWP from gendered livelihood perspectives in order to fill the socio-economic gap of the LWP framework, which mainly reflects the biophysical aspect.

The study was carried out in two case areas (*Kuhar Michael Kebele* and *Lenche Dima* watershed) in the Amhara region, Ethiopia. Qualitative and quantitative data were collected between June 2008 and February 2010. A participatory gendered livelihood and poverty analysis was made using the Gendered Sustainable Livelihoods Framework (GSLF) and Participatory Rural Appraisal (PRA) tools. Thus, multiple-use technology options were identified and targeted in an effort to suggest ways to improve productivity, gendered livelihoods, environmental wellbeing and ultimately alleviate poverty. The study also explored socio-economic and institutional gaps and solution options. In order to link technological options with socio-economic and institutional interventions, targets for LWP improvement programs were identified and characterized

The findings from wellbeing ranking and respondent profiling show that farmer households are in different groups and have distinct livelihood wellbeing characteristics (poverty status). It was found that lack of capital is the biggest barrier to

productivity in the case of poor households, out of which land and livestock ownership, particularly oxen for plowing, are the important sources of wealth. The availability of household labor is another concern for productivity improvement. Within this context, the poor, especially women-headed and young farmer households are the most disadvantaged in relation to access to resources such as land, finance and labor, which are key livelihood assets for these groups for income generation and solving of livelihood problems as they can be sold, shared and exchanged.

Regarding livestock keeping, integrated with crop production, the poor benefit less from these resources as compared to the potential due to socio-economical limitations and less capability. The poor have many limitations in accessing inputs, especially water and feed (also land for forage), which are the major variable determinants of productivity. Absence of adequate and quality feed is the foremost problem followed by diseases and a limited access to veterinary services for all groups of farmers irrespective of wellbeing status, age, and gender. The escalating human and livestock population pressure has resulted in land shortage, especially for young poor farmers. On the other hand, financial problems coupled with poor credit services, limited awareness/experience and agricultural extension services and poor socio-economic security (e.g., risk of theft and predators for women farmers) in the livestock sector are discouraging factors for the poor farmers. Moreover, considerable changes in the livestock systems of the study sites have been observed, among which shifts in feeding system, feed sourcing, livestock-keeping system and objectives, and water and grazing area management practices are identified as major factors of LWP for livelihoods and gendered poverty issues. Thus, identifying and targeting livestock development interventions, especially those integrated with water development works, considering site, wellbeing, and gender issues is important at both household and community levels. Empowerment of these disadvantaged and/or vulnerable groups in an integrated approach needs to consider different socio-economic strategies and cultural and institutional contexts than only single technical interventions.

Among the major livestock inputs, water is the main limiting factor for livestock productivity; it affects feed availability, animal health and production performance unless integrated and efficiently used, and water scarcity strikes farmers regardless of their regional, wellbeing and gender differences. The MUS comparative

analysis for LWP of the existing water sources demonstrates that in the study sites, livestock have neither been considered in the domestic water supply nor in the irrigation development interventions. Relatively speaking, the privately owned water sources like water-harvesting domes and home-connected pipes in *Lenche Dima* and hand-dug wells in *Kuhar Michael* provide better multiple use services than the government water structures such as hand-pumped and piped boreholes, spring enhancement and canal irrigation systems. On the other hand, drinking water for livestock is still scarce, especially during the dry season in *Lenche Dima* and the wet season in *Kuhar Michael*. Besides, the domestic water supply structures in both areas and the home-connected pipe water in *Lenche Dima* in most women-headed households are still limited to domestic purposes. The unevenly distributed rainwater harvesting domes, though used for multiple purposes, have limitations when coping with climate change. In *Kuhar Michael*, open and unprotected hand-dug wells and pits have exposed both human and livestock to the risk of injury and thus need protection. Spring enhancement has led to uncontrolled water flow resulting in wastage, which needs to be minimized.

The results of this study reveal that the MUS approach like 'domestic plus' on the domestic water structures at both the community and household levels is vital if they are to be efficient. Options to improve water access and productivity include strategic placing of protected watering troughs in the grazing areas and at water distribution points, integrating backyard farming with the private water sources with due consideration of economical analyses and land, labor, and financial limitations, gender-balanced groundwater development and scaling up of runoff water harvesting with soil and water conservation/management measures; improving hand-dug wells by preventing collapsing to access the potential groundwater source and improve clean water availability, and integrating fishery with the flood-plain rice production with further studies on appropriate technologies and fish species.

However, for effectively integrating livestock and water productivity improvement efforts, the complex interactions in the mixed crop-livestock system from livelihoods perspective need to be considered, as proposed technical strategies might be site specific and social-group dependent. The capability analysis of the different groups of poor households makes it possible to identify the following disabling factors that include (a) lack of appropriate, cost-effective, and labor-saving technologies to access

water and feed, (b) improper targeting of participants in livestock and water development programs, (c) disintegration of diversified productive livelihood activities by households, (d) communities' low level of awareness regarding use of different assets and services, (e) risk-averse mentality in these households, and (f) inability to cope with vulnerability contexts, especially in the course of climate change impacts.

Moreover, socio-cultural and institutional issues in the governance and management activities related to management of communal water and grazing land resources are among the disabling factors. Social and institutional analyses reveal free grazing and weak enforcement in protected areas (enclosures and irrigation schemes); upstream-downstream water-use conflicts and weak collective action for irrigation canal maintenance; destruction/degradation around irrigation canals and water distribution points; poor community cooperation in pond and other communal resources management works; improper targeting and inefficient credit and extension services regarding livestock; and conflicts in farmland sharecropping arrangements are the major ones. These factors impact LWP improvement efforts for poverty reduction partly due to weak performance and loose integration of local institutions.

To conclude, women and young poor farmers were found to be suitable targets for LWP improvement programs. However, a number of challenges were identified, among which access to and ownership of basic resources including livestock, households' preference and capability (financial as well as technical), institutions and socio-cultural issues were the major ones. On the other hand, lack of environmentally, economically and socially efficient technologies, especially to access water and feed, improper targeting of participants in livestock and water development programs, poor integration of productive use of water in the livelihood activities of poor households, and limited awareness of the community with respect to the different services provided by governmental and nongovernmental institutions are the other barriers to keep livestock, improve LWP and hence livelihoods. Thus, it is vital for the target groups to have access to multifunctional animals. Likewise, intervening to improve awareness, resource access, technical support for diversified livestock and water-related activities, and improving institutional networks at both local and communal levels are necessary. Generally, an integrated and well-targeted approach needs to be exercised in order to effectively implement the programs and successfully achieve the intended objectives.

1 INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Overview of rural livelihoods and poverty in Ethiopia

Ethiopia is endowed with abundant natural resources including water and livestock and suitable environments, which are the basis for development. In spite of this potential and the recent consistent economic growth, the country is still among the poorest nations in the world, ranked as 157th out of 169 countries (UNDP Human Development Report 2010 http://hdrstats.undp.org/en/countries/profiles/ETH.html). According to the CIA World Fact book 2010 (https://www.cia.gov), about 39 % of the people live below the poverty line (<$1/day/head). The IFAD report (www.ruralpovertyportal.org) also shows that more than 12 million people are chronically or periodically food insecure.

The largest group of poor people in the country is composed of small-scale farmers and herders. As a result, the incidence of poverty is greater and more severe in rural areas where the great majority of the poor people are found (Tayler et al. 2007: 5). This is due to low agricultural productivity resulting from environmental degradation, limited access to natural assets particularly land and water, and vulnerability to climatic conditions like dry spell and drought in the moisture-deficit areas of the country. Consequently, poverty reduction and food security are serious concerns for Ethiopia and hence accelerating agricultural growth (food crops, livestock, and cash crops) and improving of water productivity are undoubtedly important. It is to be noted that agriculture in Ethiopia is dominantly rain fed and accounts more than 97 % of the food crops production (FAO 2007; Wani et al. 2009: 3). What is more, agriculture is the base of the livelihoods of the majority of the people in the country (about 83 % of the total population) and contributes about 50 % and 60 % of the GDP and the export market respectively (CSA 2007).

Notwithstanding the multiple dimensions and contextual meanings of poverty, lack of access to a reliable water supply for both domestic use and productive purposes is a central feature of poverty in developing countries (http://pdf.usaid.gov/pdf_docs /PNADA852.pdf). It is evidenced that poverty in Ethiopia is directly related to timely accessibility of water both in quantity and quality. The death of many people and livestock in 1984/85, the starvation of about 14 million people in 2006 (MoARD 2006), and the emergency food aid need for 6.2 million people in 2009 (USAID 2009 at

www.fews.net/Ethiopia) can be cited to substantiate the issue. Such incidents primarily happened as a result of crop failure due to successive poor rainy seasons and drought. This, in fact, is a clear indication of how water is a significant factor in poverty reduction particularly in the rain fed agriculture-based society of the country.

Livestock, the integral part of the agricultural system in the country, serves as a buffering asset or safeguards resources in case of crop failure and similar disasters in water-scarce areas. Thus, in the rain fed mixed crop-livestock system of Ethiopia, particularly in the highlands, productivity improvement in the livestock sub-sector can play a key role in overall enhancement of the system; and hence improves the livelihoods of the poor people (Peden et al. 2007, 2009 and Haileslassie et al. 2009).

Here, it is important to underscore that Ethiopia has diverse climatic conditions and topography with elevation ranges from the lowest point (-110 m.a.s.l) in the Afar depression to the highest point (4620 m.a.s.l) Ras Dashen mountain. In the Ethiopian highlands where altitudes range from 1500 to 3000 m.a.s.l, a mixed crop-livestock production system dominates. The availability of adequate rainfall and moderate temperatures make this area suitable for grain production and livestock rearing with high integration of crops and livestock (Solomon et al. In: ESGPIP 2008: 28). The Ethiopian highlands cover about 44 % of the country, comprises the largest proportion of livestock (75 % of the country total) (FAO 2006), and supports about 70% of the livestock production (Tilahun et al. 2005: 1-2). The livestock system in this area provides 53 % of output value and 80 % of cash income (Tegegne et al. 2009: 8). This being the case, every effort to improve livestock productivity needs to be well assessed and carefully implemented with due recognition of the reality on the ground with respect to the multifaceted nature of the rural livelihoods.

To put it in a nutshell, through a well thought-out and integrated water and livestock improvement program, it is possible to ensure that the poor can benefit from water productivity gains in crop production, livestock and fishery (Earthscan 2007: 4).

1.2 The role of livestock to rural livelihoods in Ethiopia

In many developing countries like Ethiopia, livestock is central to rural poor livelihoods. It serves as a natural, physical, productive, financial, and social asset for food security and poverty reduction. With some regional variations, it is estimated that

livestock contribute to the livelihoods of 60-70 % of the Ethiopian population (Halderman 2004: 2). With 28.4 TLU, Ethiopia is the leading country in livestock population in Africa (Sandford and Ashley 2008: 1). The widely available communal grazing land and crop residue that could be produced without additional water makes the country suitable for livestock production particularly in the mixed crop-livestock systems (Peden et al. 2007, 2009). In this system, livestock are used as a source of cash, savings and insurance. Cattle are the dominant livestock species mainly kept for draft power while sheep and goats are used to meet small and immediate cash needs (Solomon et al. in ESGPIP 2008: 28).

Despite the abundant and diverse livestock available, it appears that the country is getting limited benefit from this resource, i.e., below the potential both at micro- and macro-levels (Birhanu et al. 2007:1) mainly due to low productivity. Inter alia, feed and water shortage, disease and poor veterinary services, lack of appropriate technology, limited attention, poor extension and credit services, lack of integration with natural resources such as land and water development and management works (Birhanu et al. 2007; Tilahun et al. 2005), and problems related to policy and strategy for livestock development (Halderman 2004: 3) can be mentioned as factors that contribute to underutilization of the resource. The driving forces behind these factors include vulnerability contexts like population pressure, agricultural intensification and degradation of natural resources, shocks through drought and floods and erratic rainfall especially in dry areas.

Apart from low productivity, livestock have become a major concern for water productivity especially in the mixed crop-livestock system of the Ethiopian highlands for two reasons. Firstly, mismanagement has aggravated water scarcity through depletion and pollution. Secondly, past experience shows that little attention has been given to the integration of livestock and water development and management works. This was observed in the study sites, which resulted in food insecurity thereby threatening the livelihoods of the poor (Descheemaeker et al. 2009 and Ali 2009). Most of the women-headed households are poor and more vulnerable groups. In this connection, it is vital to improve agricultural and livestock productivity by preventing water depletion and environmental degradation. Gender-sensitive intervention is the other critical issue for improved livelihoods, equity, and poverty reduction.

Previous investments in agricultural water development in Sub-Saharan Africa (SSA) resulted in low returns and were environmentally and economically unsustainable due to poor integration of water and livestock development and their biases to crop productivity (Peden et al. 2009: 188). Integration of water and livestock at community, landscape, system, and basin level is possible through different approaches such as institutional arrangements, sector integration and by targeting different groups of communities. However, unless well targeted, integrating water use and livestock at household level in a gendered equitable way is challenging. This is because, different groups of farmer households have different objectives, preferences, priorities and shortcomings in relation to keeping animals for their livelihoods, though there are some common interests. Thus, household analysis is highly important in order to see both inter- and intra-household structures and characteristics and to identify households' capability to integrate these resources.

In order to better ameliorate the aforementioned challenges of livestock and water integration, researchers have devised a Livestock Water Productivity Framework (LWPF) that comprises four strategies. These are planned feed sourcing, enhancing animal production, conserving water resources, and careful provision of drinking water (Peden et al. 2007, 2009: 190). However, the framework (see section 2.2.1) only visualizes the bio-physical aspects of water and neglects the socio-economic aspect. In other words, the framework takes water as a sole input and ignores others such as labor, finance, time etc., which ultimately overestimates the Livestock Water Productivity (LWP) value. Recognizing this, van Hoeve and van Koppen (2005) suggest that improving livestock water productivity requires a gendered approach involving socio-economic interventions along with conventional natural resources management, which is given less attention in the livestock sector in the country; it is totally nonexistent in the Amhara region.

1.3 Gender and livestock

Gender refers to culturally based and socially constructed expectations of the roles and behavior of women and men. It mainly focuses on the relationship between men and women, their roles, their access to and control over resources, the division of labor, participation in decision-making and their needs. Gender relations determine household

security, wellbeing of the family, planning, production and many other aspects of livelihoods (IFAD 2009: 1; IDS 2000: 4).

Historically, women's productive roles have been ignored or under-valued, practically in the informal sector and subsistence agriculture, which has led to misconceived development projects; e.g., the service of extension agents and agricultural inputs being targeted at men undervaluing women's labor. Thus the formal documentation and recognition of women's roles and the related time burden is crucial for gendered-sensitive development interventions (IDS 2000: 8).

As an important component in agricultural systems and a key asset for rural livelihoods, livestock offers advantages over other agricultural sectors and is an entry point for promoting gender balance in rural areas. This is because, livestock provide opportunities for all household members to involve in productive activities through accessing them based on their respective roles and responsibilities. It also provides year-round job opportunities and benefits in cash or in kind to the household. Livestock offer the potential for introducing a range of interventions relating to gender mainstreaming. In addition, livestock benefit the poor, specifically women, in decision making and empowerment, household welfare, income generation, self-esteem, and access to credit (IFAD 2009; Bravo 2000). Livestock management and ownership involves gender-differentiated issues, which are regionally varied and influenced by socio-cultural norms and economical factors. For instance, men are usually observed to own and manage large animals like cattle, camels and equines while women do with small animals such as goats, sheep and poultry. Moreover, women and men of different ages often have different and quite specific knowledge about, and responsibilities for, various aspects of animal husbandry and livestock production; they involve in livestock-related activities differently.

Women play an important role in livestock management, processing, and marketing. Despite their considerable involvement and contribution, their role has often been underestimated and sometimes even ignored, partly due to the attitudes of the women themselves, who underestimate the value of their work. In addition, women's contribution is rarely reflected in research and project reports and national statistics since ownership is usually expressed in the name of the head of the household, i.e., men. While women undertake a great majority of livestock-related work, men are often

considered as the sole 'farmers' with the prime responsibility of livestock (www.heifer.org).

There are also a number of challenges that women typically face more than men. Among others, they have unequal access to and control over livestock and other related resources like land, water, labor, technology, and credit, extension and veterinary services. Moreover, there are instances where women lose their livestock possession due to socio-cultural factors such as divorce and death of the spouse, which greatly impacts their livelihood as livestock are their "food security" bank, potential draft power, fertilizer, and source of income (FAO 2005: 8 and 14; Bravo 2000: 9). Consequently, women remain disadvantageous in both production and productivity of their livestock-keeping activities. In general, gender-sensitive technologies, access to land rights (whether as private property (inheritance), usufruct rights on common property resources or direct purchase/lease from the market), credit and extension services, water, especially in irrigation development, etc., all have impacts on their livelihood strategies and choices, capabilities, food security and social status (Agarwal 2003).

Therefore, in order to target livestock productivity improvement program, there is a need to assess and understand the importance of livestock for men and women, the various gender roles and responsibilities in livestock management, and the intra- and inter-household social, economic and cultural roles of livestock. Furthermore, other seasonal issues need to be duly considered: migration of farmers and livestock, relation between livestock and other agricultural and domestic activities, and gender-disaggregated seasonal occupation and sources of income. It is to be noted that gender is the focal point in the proposed LWP improvement program for various reasons. To begin with, the productive use of water in relation to livestock is quite different for men and women. The LWP strategies (see section 1.2 and Annex Table 2) or interventions will also impact men and women, differently and different members of households will respond differently. Moreover, technological innovations are not gender neutral; their design, timing and labor requirements would have different implications for women and men (Mapedza et al. 2009 draft paper: 12-13).

1.4 Statement of the problem and justification

Water is the key natural resource in livestock production and is mainly used for drinking and feed purposes. Climate change, the ever-increasing demand, and mismanagement of land and livestock are some of the foremost factors that contribute to the scarcity of water. Water scarcity to a great extent affects both pastoral and mixed crop-livestock systems. In the mixed crop-livestock system of the Ethiopian highlands, farmers use open-access communal grazing lands as a primary feed source. However, most of these communal grazing lands are becoming increasingly overgrazed and are shrinking due to the expansion and intensification of cropping on one hand and increase in the animal numbers on the other hand. These days, even marginal lands that are only suitable for grazing are being used for cropping (van Hoeve and van Koppen 2005: 9). Though they regionally vary, these degradation problems are relatively serious in the northern highlands, i.e., the Amhara and Tigray regions (Pender et al. 2001: 8).

Amhara is one of the most populous regions in Ethiopia with enormous water and livestock resources. About 25 % of the Ethiopian population resides in the region, out of which the lion's share (nearly 90 %) lives in rural areas engaged in subsistence crop-livestock mixed agriculture activities (CSA 2007: 1). Livestock, which represent about 29 % of the country's total, significantly contribute to people's livelihoods and constitutes about 17 % of the regional economy (Descheemaeker 2008: 8).

Despite the ample natural resources, an overwhelming number of people in the region suffer from poverty and food insecurity. Out of the 105 w*oreda*s (of the region), 48 of them were classified as drought-prone and food-insecure areas (Figure 1.1). In most cases farmers are exposed to food insecurity for more than six months (AMAREW 2000:1) and depend on programs like food aid, food for work and productive safety net (Taylor et al. 2007: 4). The problem is principally caused by low agricultural productivity due to recurrent drought, land degradation, floods, and poor cultivation and livestock management practices.

Furthermore, access to clean water and sanitation is the other major concern for around 30 % of the population in the region. This makes the local community vulnerable to water-borne diseases. This is partly explained by low water productivity and limitations in using appropriate technologies and effective approaches. There are also some places where seasonal flooding causes crop damage.

Livestock also suffer from seasonal shortage of feed (grazing land) and water. Diseases related to feed shortage, seasonal flooding of grazing lands in downstream areas and overgrazing in the uplands are some of the factors that affect productivity. Livestock mortality rates are high, with 40-50 % for sheep and goats and 10-20 % for cattle in time of severe water and feed shortages and disease outbreaks (Descheemaeker 2008: 36).

Figure 1.1 Map of Amhara regions with food-insecure and food-secured woredas (source: ANRS FSDPO-PSNP, 2007).

Taking into account the aforementioned problems, various poverty reduction interventions have been applied by both governmental and nongovernmental bodies. Agricultural extension, food security and productive safety nets, integrated watershed management, rural water supply and sanitation, small-scale irrigation and resettlement programs were among such endeavors. This being the case little has been done with respect to livestock. Out of the agricultural research conducted in the region, the biggest share (77 %) focused on crop production, while the remaining 23 % focused on livestock, natural resources and socio-economic aspects (Descheemaeker 2008: 9). Breed improvement (through Artificial Insemination (AI) and selection), animal production and fattening, and feed treatment were the major areas of research in the livestock sector, but fodder production and grazing management got little attention.

It appeared that most of the efforts made could not tackle the existing problems in the region since they were not integrated. Water and livestock development works for instance, were treated separately by the respective water and agricultural sectors. Although gender mainstreaming is a major agenda of rural development policy, gender-based work especially in the livestock and water sub-sectors has been given less attention. This study is therefore, conducted with the aim of filling the existing research gap and thereby contributing to the poverty alleviation endeavor of the region in particular and the country in general.

1.5 Objectives

This study is part of a BMZ-funded project entitled "Improving water productivity for crop-livestock system of Sub-Saharan Africa" that aims at optimizing productive use of water to improve livelihoods of small-scale farmers in the mixed crop-livestock systems and at mitigating land degradation in the semi-arid areas of Zimbabwe (southern Africa) and Ethiopia (Blue Nile Basin). In order to develop and promote options for enhancing water productivity through improved and integrated management of livestock in this system, the project targeted six research outputs. Among these, "*multiple-use technology options*[1] *for crop-livestock systems that contribute to positive gender, livelihoods and poverty impacts*" is the springboard for this dissertation study.

[1] Multiple-use technology options are technology or strategy options that help to improve livestock water productivity for multiple benefits to livelihoods and gender equity while minimizing pressure on the environment and natural resource base.

In light of this, the study has considered the gaps identified in the suggested framework and strategies (Figure 2.2), but mainly the social science aspect of LWP. Generally, the study identified and targeted multiple use technology options that could improve water productivity/livestock water productivity, which in turn contribute to gendered livelihood improvement, poverty reduction and environmental wellbeing.

More specifically, this study:

1. identified gendered livelihood gaps in the use and management practices of livestock and water through exploring the existing realities on the ground;
2. appraised solution options for the problems identified; and
3. identified and characterized targets to LWP improvement intervention options.

1.6 Significance, scope and limitation of the study

The aim of this study is conducted in a manner to fill the gaps that exist with respect to targeting interventions to appropriate place, time and target groups. As identifying technical gaps and interventions is not enough to meet poverty reduction goals, the study also analyzes the livestock water productivity (LWP) problems from the livelihoods perspective. Accordingly, appropriate targets were identified for different interventions so as to interlink technical, policy and institutional interventions with gendered poverty reduction purposes. The scope of the study is limited to two sites representative of water-stressed and surplus-moisture areas in Amhara region.

The findings of this study to a large extent depend on qualitative information gathered from farmers and agricultural experts. As a result, a subjective element is inevitable, which might influence the output of the study to some extent. In the course of preparing this thesis, certain challenges were faced. To start with, it was difficult to reach farmers for the PRA exercise, especially in *Kuhar Michael*. It was possible to meet the farmers only at the weekends and during their break time during orthodox Christian holidays. Consequently, the data collection process took longer than planned. Lack of commitment on the part of the participant farmers was also observed. There were instances where the targeted farmers invited for exercises were not representative, which constrained the findings to some extent. Furthermore, logistic, financial and time constraints were faced.

1.7 Outline of the thesis

This thesis is structured in to eight chapters. The first chapter deals with introduction and background of the study. The poverty situation in Ethiopia, specifically the crop-livestock system and poverty reduction programs in relation to water and livestock, are described. The problems in the study area (Amhara region) are also stated.

The second chapter deals with the theoretical and conceptual background of analytical approaches. These include the theoretical concept of sustainable livelihoods in general and the frameworks of the gendered sustainable livelihoods, the livestock water productivity and the multiple-use approaches. The linkages among the conceptual frameworks are also dealt with in an effort to depict the basic issue of water productivity/livestock water productivity in particular from the perspectives of gendered livelihoods and poverty reduction.

The third chapter presents the methods and tools used and data management processes, while the fourth chapter contains a comparative description of the study sites. Livestock husbandry in general and the study sites in particular are dealt with incorporated in the fifth chapter, whereas in the sixth chapter the main research findings are analyzed and discussed.

A summary of the thesis along with concluding remarks is presented in the seventh chapter, while in the last chapter a possible course of action is presented.

2 THEORETICAL AND CONCEPTUAL FRAMEWORKS

2.1 The sustainable livelihood approach and sustainable livelihood framework

The term livelihood refers to an outcome of the way people organize to transform the resources in an environment to meet their needs through technology, labor, power, knowledge, and social relations. It considers different capabilities, choices, composition and internal dynamics of households including gender disparity and is shaped by a multitude of socio-economical and political factors (Linden 2001).

The origin of the livelihood perspective and livelihood concepts: The origin of the livelihood perspective is the concept of changes in rural development and poverty. Before the 1980's, the focus of poverty analysis was mainly income, which was assumed to be obtained from agricultural activities in rural areas, ignoring taking in to account other vital aspects of poverty such as vulnerability and social exclusion (Lasse 2001: 6). Rural areas were seen primarily as the production site for agriculture while rural development was perceived as derivative of agricultural development. Accordingly rural development policies focused solely on farming and neglected other rural economic activities. During this period, policy perceptions and visions about farming and the development of the agricultural sector were dominated by the paradigm of agricultural modernization, which advocates improving farm production through the use of improved technologies and more financial investments (like in the green revolution approach). While farming is certainly an important factor in rural economies, rural areas contain a wide range of economic activities. It was only when new rural development paradigms (for instance the diversification of rural economy) have emerged that the rural economy taken into account, incorporating rural economic activities while highlighting diversity of rural development processes (http://www.livelihood.wur.nl).

According to Long (2001), the livelihoods approach has not only evolved as a response to the modernization perspective but has also been the subject of critical lively debate on development theory and perspectives that has been ongoing since the early 1980s. The prevailing development theories and approaches (like modernization and Marxism) were seen as overly prescriptive and strongly influenced by ideological discourses based either around the free-market model or that of state control and central

planning, i.e., development trajectories towards a capitalist system. But the real situation revealed the co-existence of small- and large-scale farming that indicated heterogeneity is the dominant feature of development in many patterns than homogeneity. In the debate, it was also felt that local people's capacities should not be ignored and their voices needed to be heard more in research and development planning. Accordingly, the so-called participatory approaches in (rural) development projects were increasingly applied in the 1980s in order to motivate the people to be actively involved in planning and implementation of policies and interventions, i.e., a 'democratization' of rural development practice. Moreover, a gradual shift in thinking about social change has led to a greater emphasis on people's agency i.e., their capacities to change both their lives through individual and collective action and the structures of society. Following this line of thinking increasing emphasis was given to people's own activities whereas previously the focus of development studies was mostly on macroeconomic structures and government policies.

Thereafter, the concept of 'sustainable rural livelihoods' increasingly became central to rural development, poverty reduction and environmental management programs. The qualitative poverty level became a key criterion in the assessment of livelihoods. Equally important, wellbeing and capabilities[2] that provide a wider definitional scope for the livelihoods concept was also considered, in such a way that a wellbeing approach to poverty and livelihood analysis may allow people themselves to define the criteria that are important and may result in sustainable livelihood outcome criteria, including diverse factors such as self-esteem, security, happiness, stress, vulnerability, power, exclusion, as well as more conventionally measured material concerns (Chambers 1989). Moreover, livelihood adaptation, vulnerability and resilience and natural resource base sustainability[3] became other major issues in rural livelihoods (Scoones 1998: 6-7). Vulnerability and resilience refers to the ability of a

[2] Capabilities in this context taken as 'what people can do or be with their entitlements', a concept which encompasses far more than the material concerns of food intake or income and represent more than the human capital which allows people to do things, but also the intrinsically valued elements of 'capability' or 'wellbeing'.

[3] Natural resource base sustainability refers to the ability of a system to maintain productivity when subject to disturbing forces, whether a 'stress' (a small, regular, predictable disturbance with a cumulative effect) or a 'shock' (a large infrequent, unpredictable disturbance with immediate impact). This implies avoiding depleting stocks of natural resources to a level that results in an effectively permanent decline in the rate at which the natural resource base yields useful products or services for livelihoods (Scoones 1998: 6-7).

livelihood to be able to cope with and recover from stresses and shocks, which are central to the definition of sustainable livelihoods and key to both livelihood adaptation and coping. Those who are unable to cope (temporary adjustments in the face of change) or adapt (longer term shifts in livelihood strategies) are inevitably vulnerable and unlikely to achieve sustainable livelihoods. Vulnerability can be also defined in terms of exposure, capacity and potentiality through three distinctive processes, i.e., entitlement, empowerment and political economy (Watts and Bohle 1993: 18-21).

In relation to this, according to Stephanie (2007), in 1987, a report by an advisory panel of the World Commission on Environment and Development (WCED) stressed the need for a new concept to address both equity and sustainability and termed it 'sustainable livelihood security'. Consequently, Robert Chambers, Gordon Conway and others working with the Institute of Development Studies (IDS) and the International Institute for Sustainable Development (IISD) developed the Sustainable Livelihoods (SL) approach in the mid-1980's to bridge initiatives centered on the environment, development and livelihoods. In order to arrive at a more holistic understanding of poverty, the SL approach builds on the Integrated Rural Development (IRD) model, participatory development and basic needs approaches, food security studies, and sector-wide approaches (DFID 2003; Haidar 2009). It also incorporates other types of analysis related to households, gender, governance, and farming systems (Farrington et al. 1999: 2).

In short, the sustainable livelihood approach has evolved from thinking about poverty as a problem of lack of income, through the basic needs approach, to an emphasis on food security and vulnerability, and finally more recently to an approach to poverty programmes that focuses on the provision of health and education services by governments. It encompasses elements of all these aspects, but focuses on capacities, assets and strengths rather than on weaknesses and constraints. It is generally seen as a successor to the integrated rural development approach and has commonalities with contemporary area and community based development approaches (Thomson 2000: 1).

As a result, the study or analysis of livelihoods in general has become relevant to understand poverty and poverty alleviation. It helps to develop a full understanding of all dimensions of the vulnerability contexts and to identify those trends, shocks and aspects of seasonality that are of particular importance to livelihoods; efforts can then

concentrate on understanding the impact of these factors and how negative aspects can be minimized. This requires a prior understanding of the nature of local livelihoods, types of livelihood strategies employed by local people and factors that make it difficult for them to achieve their livelihood objectives. Such understanding could be gained with social analysis so that particular social groups and their relationship with factors of vulnerability contexts can be identified (DFID 2001). Moreover, it helps to assess local development impacts on a broad range of livelihood and poverty reduction issues beyond the intended consequences and target beneficiaries of interventions than the commonly applied methods that focus on the achievement of predetermined objectives of existing projects through planned activities (ODI 2002).

The sustainable livelihoods approach: Livelihood encompasses the capabilities, assets and strategies (path ways or activities) required for a means of living and generally deals with people, their resources and what they do with them. It essentially revolves around resources such as land, crops, seed, labor, knowledge, livestock, money, social relationships, etc., and their connections with the issues and problems of access and changing political, economic and socio-cultural circumstances. However, in order to be sustainable, a livelihood must be adaptive and able to withstand stress and shocks, maintain and enhance its capabilities and assets, and should also safeguard, rather than damage the natural environment and provide sustainable opportunities for the next generation (Carney 1998: 4). Sustainability of livelihoods is defined in a broad manner and implies:

1. The ability to cope with and recover from shocks and stresses;
2. Economic efficiency/use of minimal inputs to generate a given amount of outputs;
3. Ecological integrity, ensuring that livelihood activities do not irreversibly degrade natural resources within a given ecosystem;
4. Social equity, which suggests that promotion of livelihood opportunities for one group should not foreclose options for other groups, either now or in the future. Here, gender equity could be included to promote improved livelihood opportunities equitably for men and women, children and older people in the society; and
5. Sustainable livelihoods can be understood as ″both a goal and an approach″.

Sustainable livelihoods as a goal are grounded in the real lives of the people and mean achieving "good life" which would include characteristics such as:

meaningful work, meeting basic needs, health, security, and living within an equitable and just society and in a working environment. Sustainable livelihood also creates new ways of living that enable people to meet their varied and interwoven needs without compromising the supporting ecosystems and their community. Sustainable livelihoods as an approach are rooted in particular people in specific places making decisions about sustaining themselves and their families. The approach is based on people's daily struggles, and builds upon their myriad strengths, which encompass many different priorities and strategies.

Sustainable livelihoods approaches, with their structure and diversity, help to find ways to understand the peoples' living situation and the many dimensions, dynamics and persistence of poverty in a holistic manner and more importantly, ways of finding solutions towards a better future. Achieving sustainable livelihoods requires the integration of local knowledge and community strengths with contemporary science, appropriate technology, thus enabling cross-sectoral policies, effective and transparent governance structures, education and training, and credit and investment. Thus, sharing and bringing individual approaches (local and scientific knowledge) together, it may also help to find new ways of approaching poverty and development especially in developing countries as sustainable livelihoods are about local, self-sustaining solutions within a larger system. However, this could suppress peoples' very real knowledge, abilities, and opportunities (http://sdgateway.net/livelihoods/ introduction.htm).

Access is a key issue in the sustainable livelihoods approach and has five basic dimensions that need to be considered when dealing with access to livelihood assets of the household, the community, and the wider society. These include availability (existence), accessibility (location), affordability (price), adequacy (quantity and quality), and acceptability (matching characteristics to needs and targets). The livelihood assets comprise human, social, natural, physical, financial, and recently, include political capitals[4] and their availability is influenced by forces over which people have little control, i.e., in the vulnerability context, for instance, economy, politics or technology, climatic variability or shocks like floods, droughts, armed

[4] The five livelihood capitals include: human capital (local knowledge, education, skills), social capital (social networks and affiliations), natural capital (land, water, and livestock), physical capital (infrastructure, equipment, and means of transport) and financial capital (cash and credit) while political capital refers to power and decision making.

conflicts or epidemics. A more comprehensive, but structured analysis of access to limited resources and ways for better productivity to improve livelihoods, equity and reduce poverty in resource-poor settings can be achieved through identification of key entry points and targeted action in household, community or system based approaches of sustainable livelihoods (Obrist et al. 2007).

The sustainable livelihoods approach was developed to help understand and analyze the livelihoods of the poor in order to improve the effectiveness of livelihood-related development interventions based on six principles: people centered, holistic, dynamic, and building on strengths, macro-micro linkages, and sustainability (Annex Table 1). It provides a framework to help understand the main factors that affect poor people's livelihoods, and the relationships between these factors, that in turn facilitate the planning and implementation of more effective development interventions, and hence improve the chances of achieving sustainable impacts on poverty reduction. The sustainable livelihood approach in brief:

1. Identifies existing assets and strategies available to poor and uses these as a starting point; and builds on strengths as a means to address needs and constraints;
2. Helps keep the focus on poor people and their varied livelihood assets, strategies and outcomes rather than on resources and activities;
3. Recognizes sex, gender, age, ethnicity, power and poverty status differences;
4. Makes links between policy and institutional issues, and micro-level realities;
5. Helps to understand how individual, possibly sector-specific, development interventions fit into the wider livelihoods agenda and objectives; and
6. Identifies a number of different options for supporting livelihoods, which would be negotiated together with partners and primary stakeholders, for identifying the 'best bet'/key "pressure points" that will have a significant impact on the livelihoods of the poor; but other more specific methods are required to determine which to tackle first, and how (NZAID 2006: 5-7).

The sustainable livelihoods framework is a tool used to improve our understanding of livelihoods by illustrating the main factors that affect people's livelihoods (e.g., assets and access to assets, vulnerability, policies, institutions and processes) and their typical relationships or interactions. Since a development

environment is complex, open and constantly shifting, the sustainable livelihood approach recognizes these dynamics and encourages a process approach to development interventions. The framework is people centered and emphasizes multiple interactions between the various factors that affect livelihoods, their importance, and way of interaction, which in turn helps in the identification of appropriate entry points for supporting of livelihoods-based on the result of assessing the contribution to livelihoods sustainability by existing activities (DFID/ODI, 2000). The approach puts strong emphasis on the question of sustainability in economics, environmental and social wellbeing of people, governance and policy as well as on their linkages. It uses empowerment rather than welfare, improves the productivity of existing livelihood systems and creates new sustainable opportunities by allowing the development of indicators to measure improvements and sustainability in livelihood systems (http://www.iisd.org/).

This analytical framework also helps to better understand the diverse nature, and the complexity, of social change in rural areas, where there is a wide range of processes and factors[5] that affect rural livelihoods at different levels, i.e., global, regional or local levels. The framework thus needs to accommodate such processes of social change and how they affect the configuration of available key resources and what individuals and households can do with such resources in order to deepen our understanding of social differentiation and vulnerability. It aims to be dynamic by taking into account the capacities of people themselves, the changes that take place over time, and how this affects the variety of ways in which individuals and households try to adapt and cope with the changes in their institutional and physical environment. Besides, it takes into account the ways in which people use and organize access to resources, deal and negotiate with institutions, and live and work in a particular socio-cultural-economic and historical context, which itself is the product of a particular configuration of global and local processes (www.livelihood.wur.nl/index.php?id=58).

The sustainable livelihood framework helps to organize and show the relationship of the various factors that constrain or enhance livelihood opportunities. It also helps to provide a way of thinking about livelihoods that is representative of a

[5] Factors like climatic change, environmental degradation, global trade, HIV/AIDS, economic policies (like conflicts about land, water and labour, structural adjustment, etc., all influence the way people are able to construct and sustain a living.

complex, holistic reality, but manageable. There is no real beginning, middle or end to the framework, rather the entire picture (see Figure 2.1) represents whole livelihood systems and these do not have fixed organizational structures but are characterized by repeated patterns of connections and influences represented by the arrows as feedback loops. In the figure, the asset pentagon in the center represents a graphical way of thinking through combined asset portfolios, and the shape can be used to show schematically the variation in people's access to assets (DFID 1999, Guideline sheet)

The value of a framework is that it encourages users to take a broad and systematic view of the factors that cause poverty (regardless of sectoral issues), whether these are shocks and adverse trends, poorly functioning institutions and policies or a basic lack of assets, and to investigate the relations between them. The aim is to do away with pre-conceptions about what exactly people seek and how they are most likely to achieve their goals and to develop an accurate and dynamic picture of how different groups of people operate within their environment. This provides the basis for the identification of constraints to livelihood development and poverty reduction at a local level or in the broader economic and policy environment and may relate to the agricultural sector in rural areas or they may have more to do with social conditions, health, education or rural infrastructure. However, as the framework cannot attempt to capture everything important to poverty elimination, employing a range of other tools, including stakeholder, social, gender, and economic and institutional analyses, is necessary to gain a full understanding of livelihoods and how external activities can best support these (http://www.oceansatlas.com/).

Hence, in this study, as the multiple dimensions of poverty underscore the importance of livestock to the poor, the sustainable livelihood approach and its guidance sheet developed and advocated by DFID (1999) was referred in order to understand the link between livestock keeping in the mixed crop-livestock system of the poor and the interlocking dimensions of poverty. Moreover, the components from the livelihoods and gender analysis were viewed to better incorporate the issues of gender within the SLF, i.e., the access and control, roles and responsibilities of the gender analysis framework were related to the SLF components of assets, activities and output benefits (Figure 2.1). For the LWP issue GSLF adopted from van Hoeve and van Koppen (2006) is used.

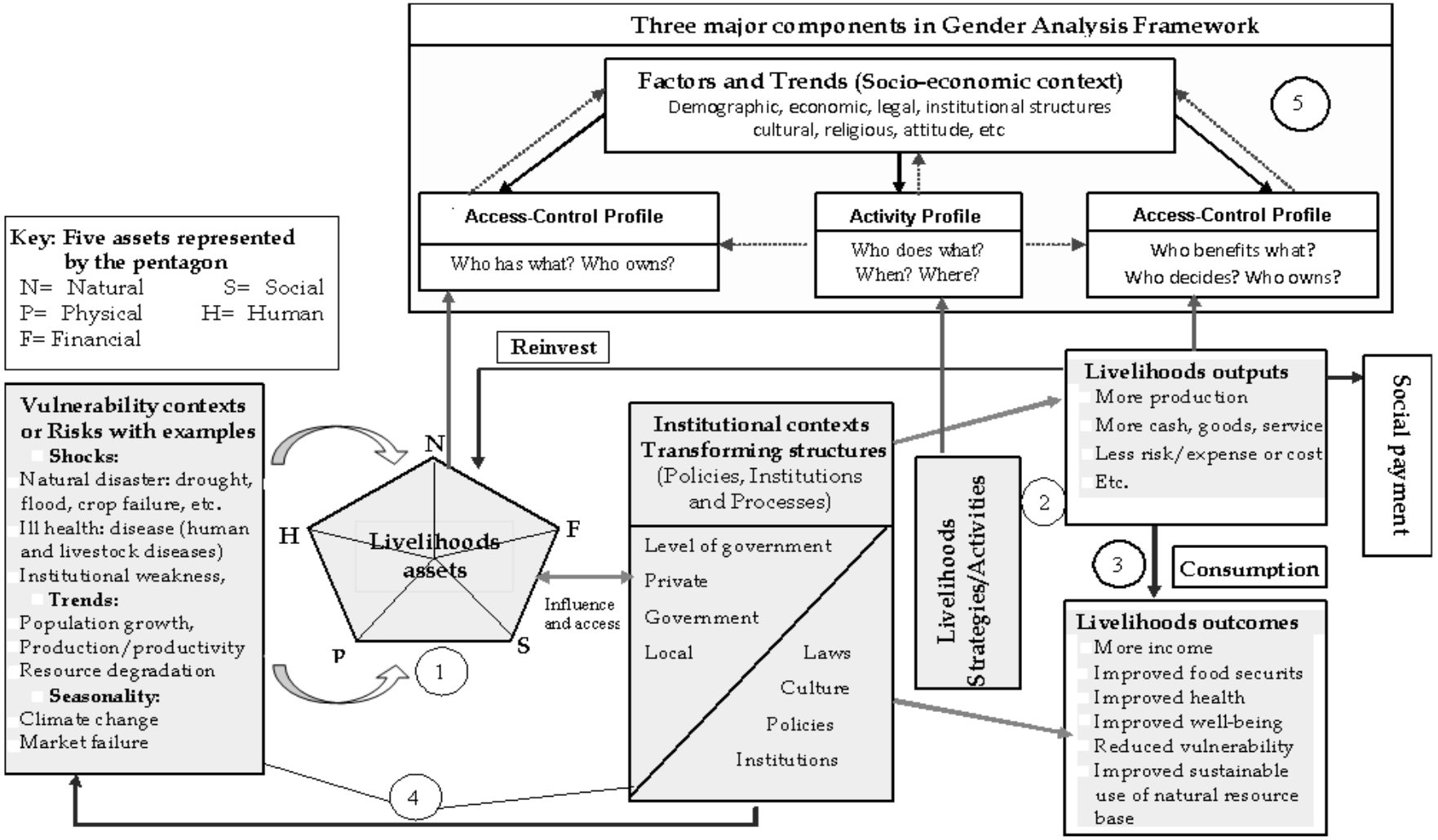


Figure 2.1 Sustainable livelihoods framework with gender analysis components (Source: Developed from DFID (1999) SLF guideline sheets and Helen Derbyshire (2002) gender manual: Practical guide for practitioners).

In the livelihood framework (Figure 2.1):

No 1: Represents the five major assets or capital endowments categorized by DFID, which are important initial points/building block/ for a livelihood strategy and activities for certain outcomes. The accessibility of these assets is the determinant factor of people's ability to escape poverty and may be influenced by external factors, and human factors like priorities, preferences, and own capability. Moreover, the quantity and quality of these assets matter, along with the options to convert assets into productive activities.

No 2: Refers to certain strategies and activities, which are designed and undertaken by people to achieve targeted outputs in their livelihoods and are influenced by external factors. Rural poor usually perform diversified types of activities, including agricultural, non-agricultural and migration for casual labor work. But strategies usually determine people's choice of which activities to combine, which outcomes to pursue, and which assets to invest in. In this thesis, livestock keeping is considered as a major activity in the rural livelihood strategies of mixed crop-livestock systems, and water management is taken as a strategy to improve livestock productivity and thus livelihoods.

No 3: Indicates the immediate outputs and the outcomes that people are trying to achieve through their livelihood activities. They can be influential factors for further livelihood improvements through strengthening the assets and their accessibility and enhancing the human capability to use these resources effectively with appropriate strategies.

No 4: Represents the external contexts that influence every activity of a livelihood. The external environment in which people operates or the vulnerability context (natural, demographic and economic) shapes people's access to assets, and the shocks and trends tend to increase their vulnerability; This is mainly a policy issue. On the other hand, the institutional contexts/transforming structures that affect the assets and opportunities that are available, and their productivity are other external influences. These include: government policies, formal organizations (farmer group, local authority), informal institutions which include societal rules and norms (network, credit system, market, discrimination) and the different socio-cultural processes and access to

markets. These components may influence the vulnerability contexts and thereby make the livelihood strategies effective.

No 5: Depicts the basic components of the gender analysis, which are directly related to the livelihood framework components of assets, activity, and outcome. These components are influenced by different external factors such as institutions, and social, cultural, political, and economical factors.

The SLF components**,** assets, strategies and activities, the different external contexts, and outcomes (along with their multitude interactions, relationships, and influence of each other), are determinant factors for the poor livelihood conditions. Whereas the arrows that connect the different components only show the relationships among these components and the influences between these. However, this does not imply any direct cause-effect relationship since all the components are dynamic by themselves.

2.2 Conceptual frameworks

2.2.1 The livestock water productivity framework (LWPF)

LWP is a water-accounting framework used to show the livestock and water interactions in a system. The framework is developed based on three major rationales. The first is poverty in the developing countries, which can be alleviated through increased food production mainly from livestock, since this is all abundant resource in these countries. Secondly, feeding livestock needs much water on the one hand and grazing leads to land degradation and aggravates water scarcity on the other. Consequently, there is a need to integrate livestock and water development so as to reduce the pressure on the scarce water resources and the environment. The latter is the possibility to reduce water used for African animal production by more than 50 % especially in rain fed mixed crop-livestock systems. In order to calculate the level of water circulating in the system, scientists devised a framework (Figure 2.2) represented by the formula depict below:

$$LWP = \sum(\text{net beneficial outputs}) = \frac{\text{Benefits (milk, meat, hides, manure, wealth savings, cultural roles)}}{\sum(\text{depleted water}) \text{ (evaporation, transpiration, discharge/flood)}}$$

Where:

1. Benefits stand for animal products and services; and

2. Depleted water refers to the amount of water that has been used and cannot be reused again by the same or another user, i.e., water evaporated, transpired and discharged from a system.

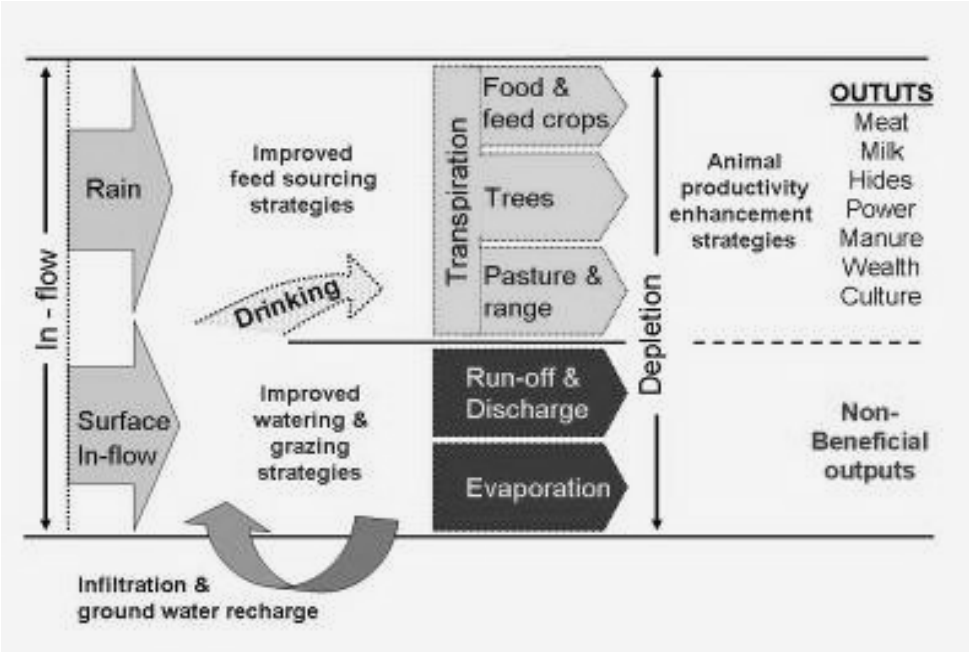


Figure 2.2 Simplified livestock water productivity framework (LWPF) (Source: Peden et al. 2006)

Water productivity generally means the ratio of agricultural outputs to the amount of water consumed and measures the ability of agricultural systems to convert water into food (Kijne et al. 2003 in Descheemaeker et al. 2009: 9). While LWP is the ratio of beneficial value of animal products and services to amount of water depleted in producing them, the LWP concept considers water as the only input for the calculation of the net benefit.

Nonetheless, water is not the only input in livestock husbandry. Rather, all efforts made in connection with access to water as well as provision of water for livestock (drinking and feed) need to be included in the calculation. Labor, time, skill/knowledge, money (for veterinary and other services), energy, and in-kind gifts are all costs associated with keeping livestock for certain valuable socio-economical benefits. Therefore, the absence of these costs in the computation inevitably overestimates the LWP value.

These costs and LWP values vary by type and status of animal species, space/location, production system, season, culture, socio-economic groups, gender lines, farmers' livelihood and biophysical settings (van Hoeve and van Koppen 2006;

Hailesilassie et al. undated: 15; Tilahun et al. 2009: 172). As the framework does not take into account the impact of these factors, this research tried to fill these gaps, and assessed their influence on the value of LWP for livelihoods and gendered equitable poverty reduction efforts.

The importance of the LWP concept is not limited to merely estimating the LWP numerically. The spatial and temporal trends and patterns in LWP may help natural resource managers to determine strategies and target interventions in a bid to get better and more sustainable returns on investments (Peden et al. 2009: 192). The spatial pattern of LWP particularly is able to depict the sustainability of livestock water interaction and the livelihoods strategies of smallholder farmers (Hailesilassie et al. undated: 4 and 9).

2.2.2 The gendered sustainable livelihoods framework (GSLF)

Keeping livestock is an important livelihood strategy and one of the major productive activities in a mixed crop-livestock system. It mainly depends on water, land, and feed accessibility as basic inputs (SLF natural assets). In order to access and use such resources human assets like labor, time, skill and knowledge are required. Inputs are provided by different social groups of actors (gender, age, wellbeing groups) with certain efforts, and the outputs derived will be shared or distributed amongst the different groups (gender and wealth groups). These efforts and outputs refer to the gendered costs and benefits of livestock keeping, which are different along gender lines and wellbeing groups.

The vulnerability contexts such as shocks of drought and disease, seasonality of feed, water and labor availability, and the increasing trends of population growth that result in increased demand for food especially from livestock are the major factors that affect productivity and the livestock contribution to livelihoods. Moreover, they are potential causes of environmental degradation and water scarcity that compels the LWP concept to improve the situation. In recognition of this, the Gendered Sustainable Livelihood Framework (GSLF) (Figure 2.3) was designed and suggested as a data collection and analytical tool by van Hoeve and van Koppen in 2005. The framework helps to assess LWP from the livelihood perspective and includes gender aspects.

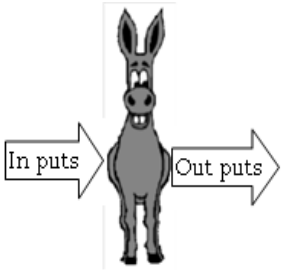
Livelihood asset (Five capitals)	Cost to access assets	Access/Control					Livestock as an asset	Benefits (outputs and outcomes)	Access/Control					Vulnerability/ Risks contexts (seasonality, shocks, trends)	Institutional contexts	
		M	W	H	C	G	Keeping livestock as a strategy/an activity		M	W	H	C	G		Local or community	Government or private
Natural Water Land Feed							Water? Feed? Land? Where? How much? In what cost (time, labor, price)? What mechanism helps to optimize water use? Who support? Who benefits?	Soil fertility Biodiversity Optimum water use								
Human Labor Knowledge Skills								Nutrition								
Physical Water-infrastructures Services								Traction Transport Energy (fuel)								
Financial Cash to purchase or pay for goods and services, e.g., medication								Income Insurance Coping								
Social Resource-sharing groups Gifts, bride price Cultural festivities							Livestock or other productive activities What type of animal? Who? and Where?	Status Social security								

Figure 2.3 *Gendered sustainable livelihoods framework (GSLF) (Source: van Hoeve and van Koppen 2006: p.5)*
Note: M=Men; W=Women; H=Household (men, women, children); C=Community and G=Government

As depicted in the framework, the first column represents the five livelihood capitals along with the list of required assets for livestock. The second column refers to the costs to access the assets and such costs are disaggregated by gender in the third column. The benefits derived from keeping livestock by livelihood capitals are depicted in fifth column, while they are disaggregated by gender in column six. The last two columns vulnerability contexts and institutional contexts are used to show the different constraints and opportunities in connection with accessing and managing assets for livestock keeping and improvement activities.

The GSLF reflects the LWP by considering water as a crucial input and analyzing it together with other inputs using the five assets of SLF and the governing structure over these assets. The governing structure refers to the access and control aspects of gender components, whereas assets include:

1. *Human capital*: the time and labor men and women use to collect water for the livestock and to maintain the water sources/infrastructures;
2. *Financial capital*: cost incurred for purchase of water and maintenance/ guarding of water structures;
3. *Social capital*: efforts to look after communal water sources collectively and other social networks; and
4. *Physical and natural capital*: value of water in terms of the accessibility, quality and quantity.

The framework is a tool used to understand both livelihoods and gender dynamics in livestock keeping activities. It analyzes the importance of livestock in the dynamics of livelihoods and the changes in roles and responsibilities of men and women in the strategy of livestock keeping. The governing arrangements (SLF structures and processes) like allocation of efforts and benefits to households are influenced by institutions such as marriage, inheritance, and parenthood. In the GSLF framework, the ownership of livestock and livestock products and the five livelihood assets are used to determine the different inputs which livestock production requires and the outputs it generates. It also dictates the governing institutions that influence the intra- and inter-household distribution.

In general, the GSLF in this study is used to:

1. assess LWP by analyzing the role of a specific animal in the livestock production system and its impact on men and women with respect to their livelihood;
2. perform a gender impact assessment on a specific technology of livestock production by considering the expected gendered costs and benefits; and
3. assess the different enabling and disabling conditions of men and women farmer households in relation to LWP improvement programs and thus to identify and characterize targets for LWP improvement interventions.

2.2.3 Multiple use system (MUS) approach

The system of multiple-uses (MUS) of water has been traditionally applied for a long time. Water has been used for different purposes without recognizing its specific impacts especially in water-stressed areas. Besides, water development interventions have been mostly for a single purpose, either for domestic use or for irrigation. However, the single use, top-down approach did not address the real needs of people. This is because, communities used to design water systems in such a way that it served multiple uses. Even if communities are provided with single-use public supply schemes, they tend to use them for multiple purposes. Such practices have resulted in health risks for water users, water shortages at the tail ends of supply systems, damage to infrastructures, and conflicts between users.

But, it is clear that if well integrated, managed and utilized, the provision of water supply and sanitation services can provide a significant potential to alleviate poverty. The provision of a water supply for irrigation can also provide the same potential by supplying water for domestic use, e.g., like drinking water for livestock, sanitation and other small-scale enterprises. However, these opportunities have received little attention in water-related development interventions. The MUS approach (Sandy and Sarah in IWMI 2006) has therefore been developed to bridge this gap.

The MUS system is "*an integrated way of planning and managing institutions, resources, and infrastructure to sustainably and equitably meet people's water demand for multiple uses to enhance their livelihood options*" (Smits et al. 2008: 125). In other words, it stands for the use of water for the additional to those purposes for which the supply system was originally intended to. This would improve access to water for

multiple benefits and gender equity, and thus productivity of a given water resource (Maluleke et al. 2005; Michikilo 2010; and Eline 2006). MUS is an alternative model for water service provision and a consumer-oriented approach that takes people's multiple water needs as a starting point. (Renwick et al. 2007: 3). It includes the facilities and water sources to accommodate these needs for effective water-based interventions and ensures multiple benefits for poverty reduction.

According to van Koppen et al. (2006: 9-20), the benefits of MUS over a single-use approach are manifold. MUS provides relatively better ways of using a water source for different productive purposes and fulfills other demands for water. Accordingly, it reduces vulnerability during drought through providing a means to supply water for the different productive activities (like livestock keeping, fishing, and backyard farming) that can contribute to food security during lean time. Moreover, MUS helps to improve health through providing more water for bathing, sanitation and drinking, reducing the incidence of water-borne diseases, and hence lowering child mortality. It also adds value in utilizing water for improved food as well as income, which in turn improves nutrition and allows people to take extra preventive health measures and pay for health services.

Generally, several benefits can be derived from the system. Gender equity, for instance can be improved particularly through supporting women by saving the time wasted for fetching water. What is more, it improves the sustainability of the water supply system by involving communities in planning and designing the system, empowering them and building willingness to pay for maintenance and reinforce services. Socially equitable and environmentally sustainable water use can also be considered in this approach.

The success of this approach, however, counts on the respective principal activities at three levels, i.e., community, intermediate, and national level. Empowering the poor at the community level is especially important as it provides livelihood-based planning and design of water services, appropriate technologies, adequate financing, equitable institutions, and sustainable water resources. While at the intermediate level, participatory planning, coordinated long-term support, and strategic planning for further MUS innovation are the main aspects. Furthermore, decentralization of support and enabling policies and laws is required at the national level (van Koppen et al. 2008: 2).

According to van Koppen (2009), for the productive sub-sectors such as livestock keeping, homestead-scale MUS would open up new opportunities for better targeting of the poor, empowering women, and assisting the incapable and the vulnerable groups.

2.2.4 The linkage of MUS approach to GSL and LWP

The linkage of the LWP approach to MUS is at the intermediate level of "MUS in the water ladder framework" (Figure 2.4) (van Koppen et al. 2009 and Renwick et al. 2007: 7-15) through livestock water management (Figure 2.5).

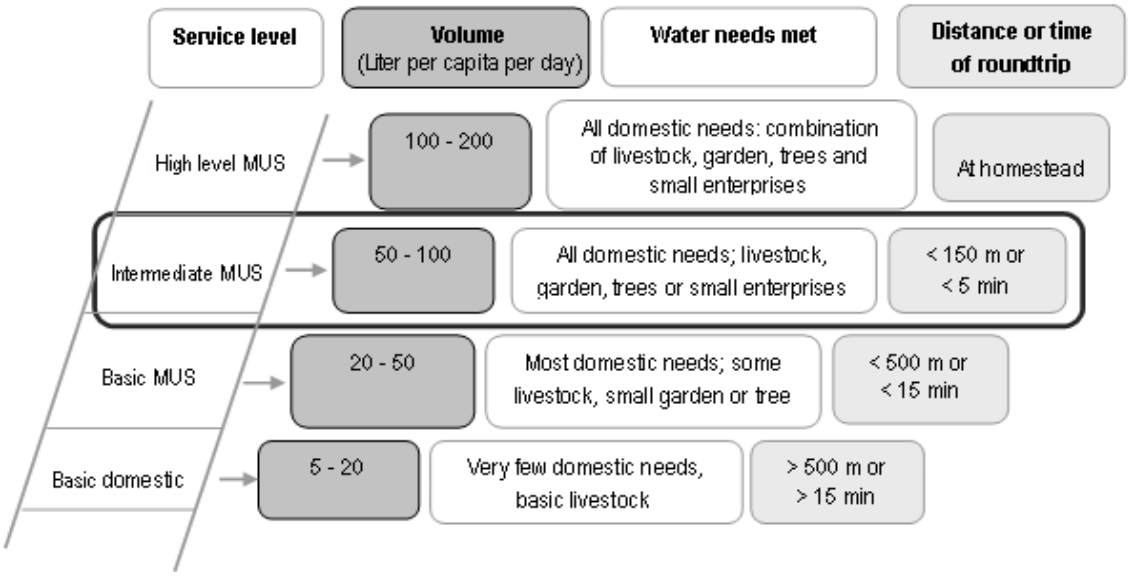


Figure 2.4 Multiple use services (MUS) water ladder framework (Source: van Koppen et al. (2009: p. 106)

MUS considers water management in two ways. At first the livestock drinking water is managed through strategic provision of adequate clean water in appropriate areas, which is common to strategy-4 of the LWP approach. The other is efficient use of water through incorporating fodder production in backyard or in irrigation areas; it is similar to the other strategy of the LWP approach, i.e., strategic feed provision through encouraging irrigation water users to produce fodder for market, thus improving income and feed supply in shortage times.

The approaches of MUS and GSLF have a common key element: water. Besides, both focus on the same target, which is improving livelihoods and gender equity for poverty reduction through water productivity improvement. However, they employ different strategies to achieve their target (Figure 2.5). The GSLF considers the

scarce water and other assets related to livestock-water as an input to livestock productivity. In contrast, MUS uses the scarce water for multiple purposes including water for livestock drinking and fodder production. Moreover, MUS considers livestock as a component of strategies to improve water productivity in the livelihood activities of the rural poor.

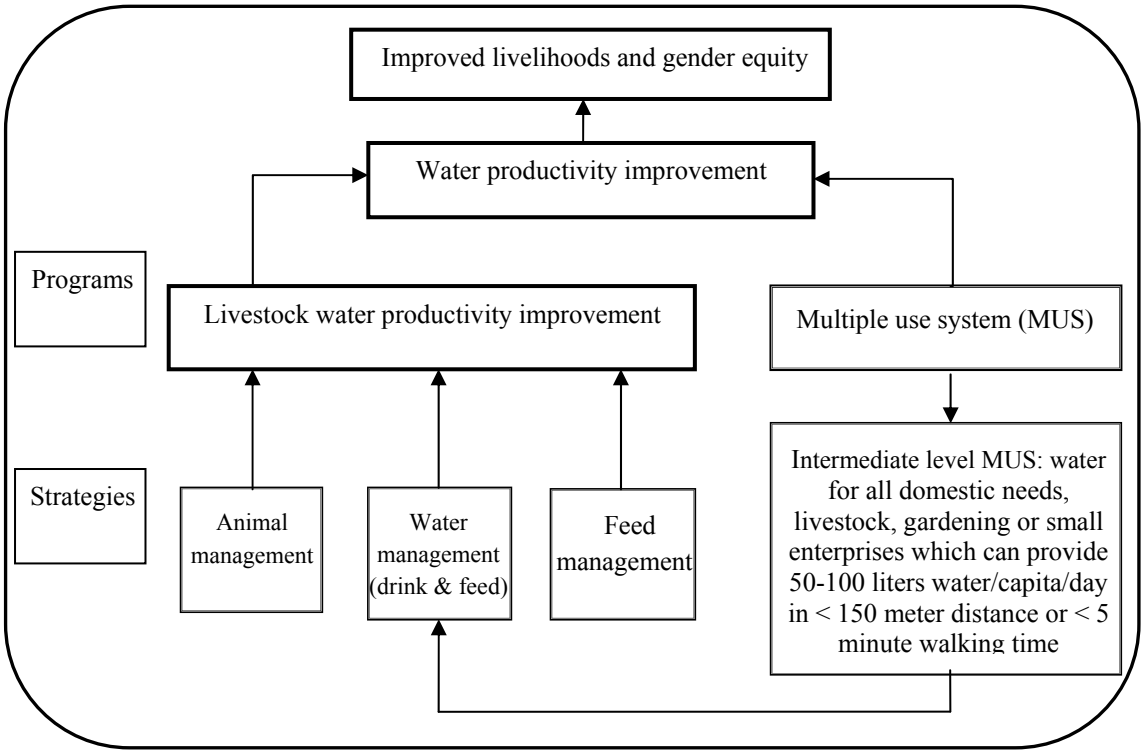


Figure 2.5 Proposed water productivity improvement programs and strategies (Source: extracted from the LWP and MUS water ladder frameworks)

2.3 Efforts made to improve agricultural productivity and rural livelihoods

2.3.1 Water, livestock and other rural development interventions

In this section, the different types of interventions[6] introduced in the past and their major impact on the communities' livelihoods and the environment are described. In the study sites, various water- and livestock-related interventions have been introduced at different times by governmental and nongovernmental organizations (Table 2.1 and 2.2). The interventions in *Kuhar Michael* focused on crop production improvement and natural resource conservation works. These include in-situ soil and water conservation, irrigation, and improved seed and fertilizer supply. Though very limited, interventions

6 Interventions here refers to rural development works introduced by different actors especially those related to water and livestock productivity improvement and other livelihood improvement related issues like health and education aspects.

were undertaken with respect to livestock including breed improvement, production improvement, animal management, and fattening programs.

In the case of *Lenche Dima*, interventions emphasized natural resource conservation works since the area is highly degraded and vulnerable to soil erosion and flooding; and hence shows reduced productivity. The interventions included check dams, gully treatment, stone and soil bunds, planting on bunds and gullies, hill area closure and protection, etc. The other focus area was production improvement works in small ruminants, especially goats.

In both sites, domestic water supply works were through various strategies and using different water sources.

Table 2.1 Interventions introduced and respective actors

Sites	Types of interventions	Actors
Kuhar Michael	- Irrigation	- Co-SAERAR and ORDA
	- Domestic water supply	- Government and FINNIDA (NGO)
	- Grazing land improvement by weed clearing, over sawing and area protection	- IPMS/ILRI
	- Feed improvement (urea treatment)	
	- Soil and water conservation	- IPMS/ILRI and government
	- Small ruminant production and fattening	- Government (agricultural office)
	- Rural energy (fuel-saving baking stove)	- Government (agricultural office) and IPMS/ILRI
	- Agricultural input supply (improved seed, fertilizer, credit)	- Government (agricultural office) - Government and, cooperatives
	- Rice introduction in the swampy area	
	- Credit for microfinance business	- Cooperative and agricultural office - Government, cooperatives and ACSI
	- Sanitation and health extension services	- Government
	- Basic and primary schools and health post	- Government with local community
Lenche Dima	- Irrigation (*Tach Alwuha K-02*)	- Co-SAERAR (government)
	- Domestic water supply	- AMAREW (UNICEF) and government
	- Hillside area closure	- AMAREW (USAID)
	- Gully treatment and soil conservation	- AMAREW (USAID) and government
	- Water harvesting, pond construction and other water conservation works	- Food security office (government)
	- Small ruminant (especially goats) production and camel fattening	- Food security with Safety-Net program (agricultural office)
	- Credit for microfinance business	- Microfinance office (government)
	- Rural energy (fuel-saving baking stoves)	- AMAREW and government
	- Agricultural extension services and input supply (like improved seed)	- Agricultural offices (government)
	- Basic school and health post	- AMAREW, local communities, government
	- Sanitation and health extension services	- Government: food security and agricultural office

Source: Development agents (DAs) at the kebeles of the study sites

Table 2.2 High impact interventions undertaken in the study areas

Sites	Interventions	Period	Actors
Kuhar Michael	-Irrigation	2000, 2003	-ORDA, SAERAR
	-Domestic water supply		-FINNIDA, government
	-Rice introduction	1983 (commencement), 1992/93 (expansion)	-Cooperative and government
	-Fattening, sheep and goat production, feed treatment and grazing land management	2007/08	-Government (agricultural office) and ILRI/IPMS
Lenche Dima	-Irrigation	1991, 2003	-SAERAR
	-Domestic water supply	2004/05	-UNICEF and AMAREW
	-Soil and water conservation, enclosure and hillside development, and gully treatment	2004/05	-AMAREW
	-Fattening, sheep and goat production, safety net program and conservation works	2000/01	-Agricultural office and FSDPO

Source: Development agents (DAs) at the kebeles of the study sites
Notes: FSDPO=Food Security and Disaster Preparedness Office
ORDA=Organization for Rehabilitation and Development program in Amhara Region
SAERAR=Sustainable Agriculture & Environmental Rehabilitation Commission in Amhara Region
AMAREW=Amhara Micro-enterprise development, Agricultural Research, Extension and Watershed Management

It was learnt that the interventions introduced in *Lenche Dima* with respect to natural conservation works helped the community to a great extent particularly by minimizing soil erosion and flood damage on their farm lands. In addition, they prevented loss of livestock (due to high run-off) and other assets. The enclosed hills were found to be covered again with vegetation that in turn benefited farmers in two ways, animal feed and source of income from sale of grass. It is worth mentioning here that poor women farmers, who represent 25 % of the participants of the hill development program, got income opportunities. Moreover, the establishment of community groups in the hill development programs contributed considerably by

facilitating team work, building networks, creating strong relationships among farmers, and hence strengthening social assets.

However, this area enclosure prevented farmers from getting access to browsing and grazing land for their animals unlike in previous times. As a result, they were forced to sell animals and were limited to less herd size and stall feeding. Farmers use the cut and carry system of feeding from the enclosed areas for stall feeding, though it is all added burden for the women as it is a labor-demanding activity.

In general, rice introduction in *Kuhar Michael,* irrigation and domestic water supply development works, limited interventions in livestock production and breed improvement, and credit and saving services contributed much to improving productivity and household income in both sites (See sections 6.1.3 and 6.1.4)

2.3.2 Agricultural extension and other rural development efforts

Agricultural extension mainly refers to the dissemination of information to achieve voluntary behavioral change of the farmers. It is also used as an instrument for policy implementation. With the goal to ensure food security at household level and improve livelihoods of farmers, agricultural extension in Ethiopia applies a packaging program for introducing new technologies and better management practices. In the study sites, however, the participation of farmers in these packages at the *woreda* level has shown a declining trend since 1999 (Descheemaeker 2008: 48). As per the information obtained from the farmers, the benefit they derived from the system was found to be very limited and only enough to cover annual food requirements. Moreover, low capacity, lack of awareness, high probability of natural hazards, and high-input and related prices are the other reasons for limited participation in the package program. In a bid to effectively implement extension packages, the government has recently taken some important measures that include improving credit services for input, upgrading the level of training for the development agents (DAs) and assigning additional specialized experts at *kebele* level (at present there are 3 experts).

The current agricultural extension packages in general are of two types: the family extension package whose main objective is to bring about an increment of annual household income by producing marketable agricultural goods (21 identified commodities from which milk, honey and wax, mutton (fattening), sheep and goat, and

fish production are from livestock sectors). In specific terms, the monetary income of each member of the participating household is expected to get 10 Ethiopian Birr per day in 3 to 5 years. The minimum extension package aims to increase productivity and production of cereal crops to reach a sufficient food supply in the region, giving special attention to maize, sorghum, wheat, teff and rice (2003/04) (Girma et al. 2004: 14-15). At the *kebele* level, these packages mainly focus on intervening in improvement of agricultural productivity, i.e., crop, livestock and natural resource development programs. The DAs are mandated and responsible for the coordination and technical support and work closely together with the farmers. Moreover, input supply (like fertilizer, improved seed, seedlings, pesticides, and herbicides) and veterinary and credit services are all accessible through these DAs. Most of the extension packages are related to crop production improvement activities. These include providing improved seed of different cereals and vegetable crops (with small-scale irrigation development), fertilizer, pesticides and herbicides, and seedlings (for soil conservation and animal feed), and facilitating credit services for purchase of inputs and animals.

In the study areas, the coverage of governmental agricultural extension packages has given relatively more attention to crop production followed by natural resource interventions especially soil and water conservation works. But in *Lenche Dima* natural resource conservation work has been given more emphasis than crop production improvement. This being the case, the livestock extension package is very limited in both sites. In *Kuhar Michael*, for instance, only 21 farmers participated in the livestock production family-based extension packages, as per the report of DAs in 2009. Likewise, livestock intervention in *Lenche Dima* was limited and focused on small ruminants, especially goat production and credit-based camel fattening programs. There is no improved forage development activity due to failure of the introduced forage seeds to adapt to the environment. Though limited, livestock interventions integrated and complemented with crop and natural resource productivity improvement works are still positively contributing to livelihoods.

2.4 Previous experiences on livestock water productivity improvement

Different research and development works have been done to improve management and productivity of agricultural water and livestock. But these efforts were mostly

discipline-based and disintegrated. Evidence shows that livestock and water were not integrally seen, neither in research nor development endeavors. Livestock are commonly claimed as water users and contributing to global warming through increasing greenhouse gas emissions. Despite their positive contribution to livelihoods, livestock may also have negative impacts on the environment due to misuse and ill-management. High stocking rates and uncontrolled grazing, for instance, have caused environmental damage such as water pollution and accelerated soil degradation and erosion especially in the hilly areas of developing countries (Delgado et al. 1999: 45). Hence, it ultimately affected agricultural productivity and farmer households' wellbeing.

In Ethiopia, the abundant population of livestock can significantly support the poor if integrally managed with water resources and other natural resource conservation works. This is because in the mixed crop-livestock system, livestock productivity improvement through water and animal management could contribute greatly to the overall productivity improvement of the system as mentioned earlier and hence improve the poverty situation. Nonetheless, environmental degradation is a major problem that is related to livestock population pressure, which constrains water and feed resources availability and accessibility in the areas.

The recently emerged concept of LWP improvement approach has come up with a possibility of minimizing the use of water by livestock especially through feed. This basically includes strategic integration of water and livestock and allocation of water for crop and livestock particularly in the crop-livestock system. The LWP strategies suggested by Peden et al. (2007, 2009) (Annex Table 2) at the landscape scale are technical. At farm and household level, these strategies might be gendered, imposing different costs and variably providing benefits to men, women, children, and other marginalized socio-economic groups. On the other hand, their implementation is site specific.

2.5 Research questions

With due consideration of the foregoing gaps, this study was therefore, conducted based on two fundamental research issues and include other detailed questions. The two basic research issues are: (1) what interventions of water/livestock development or management works would improve the livestock productivity and would impact poor

livelihoods and gender equity? (2) Which target group should participate for effective implementation of LWP improvement programs?

The detailed questions included in the study were:

1. What livelihood strategies, activities, and resources (asset base) do farmers have that would improve productivity and their livelihood wellbeing?
2. What kind of livestock do farmers have and how are they managed? What does the intra and inter farmers' households benefit distribution of livestock/water productivity improvement look like? How do the water/livestock development interventions affect activity and benefit distribution between men and women in households?
3. What are the multiple uses of water disaggregated by gender? What are the determinant factors of multiple use system to improve water productivity/livestock water productivity?
4. What development interventions, relating to water and livestock have been introduced into the study sites? How were the impacts of these interventions on livelihoods?
5. What are the key constraints in the livestock water productivity in relation to poverty reduction?
6. Which potential options or interventions would address these constraints?

3 METHODS

3.1 Selection and description of study sites

The study was conducted in two sites in Amhara region (Figure 3.1-c), which is one of the nine autonomous regional states in Ethiopia. The region covers about 170,000 km^2 with a total population of 17.2 million, which represents about 23 % of country's total (CSA 2005; CSA 2007). The livelihoods of the majority of the people (nearly 90 %) depend on agriculture, which constitutes 62 % of the regional GDP (BoFED 2001). Mainly mixed crop-livestock farming system is practiced in the region. The region hosts about 29 % of the country's livestock, which accounts for 17 % of the GDP. Livestock are mainly cattle (85 % of the TLU); other animals kept are sheep, goats, and equines. Among the many uses of domestic animals, cattle provide 90 % of the draft animal power and are also used as a source of income, food, and wealth security (Girma et al. 2004: 5).

The two study sites are *Kuhar Michael Kebele*[7] that is found in *Fogera Woreda*[8], South Gonder Zone[9] and the *Lenche Dima* watershed in *Laste-Gerado Kebele*, *Gubalafto Woreda*, North Wollo Zone, in the Amhara region (Figure 3.1-d and e). The former is located at $11^0$50'37" to $11^0$53'37"N and $37^0$38'10" to $37^0$42'17"E (Descheemaeker 2008: 10), and the latter at $11^0$49'13" to $11^0$51'57"N and $39^0$40'07" to $39^0$44'22"E (Gizaw et al. 1999: 1). *Kuhar Michael* covers an area of 2755 ha with altitudes ranging from 1792 to 1959 m.a.s.l. The area is moisture surplus with annual rainfall over 1200 mm. *Lenche Dima*, covers an area of 1546 ha with altitudes ranging from 1520 to 1890 m.a.s.l. In contrast to *Kuhar Michael*, the area is moisture stressed/drought prone due to low rainfall with an annual average of 667 mm (Ali 2009). Both sites have mixed crop-livestock production systems.

[7] *Kebele* is the least administrative unit of governmental structure
[8] *Woreda* is an administrative word, or local government, of Ethiopia, equivalent to a district composed of a number of smallest unit called *Kebele* or neighborhood associations
[9] Zone is an administrative boundary smaller than region and consists of a number of administrative *Woreda*s

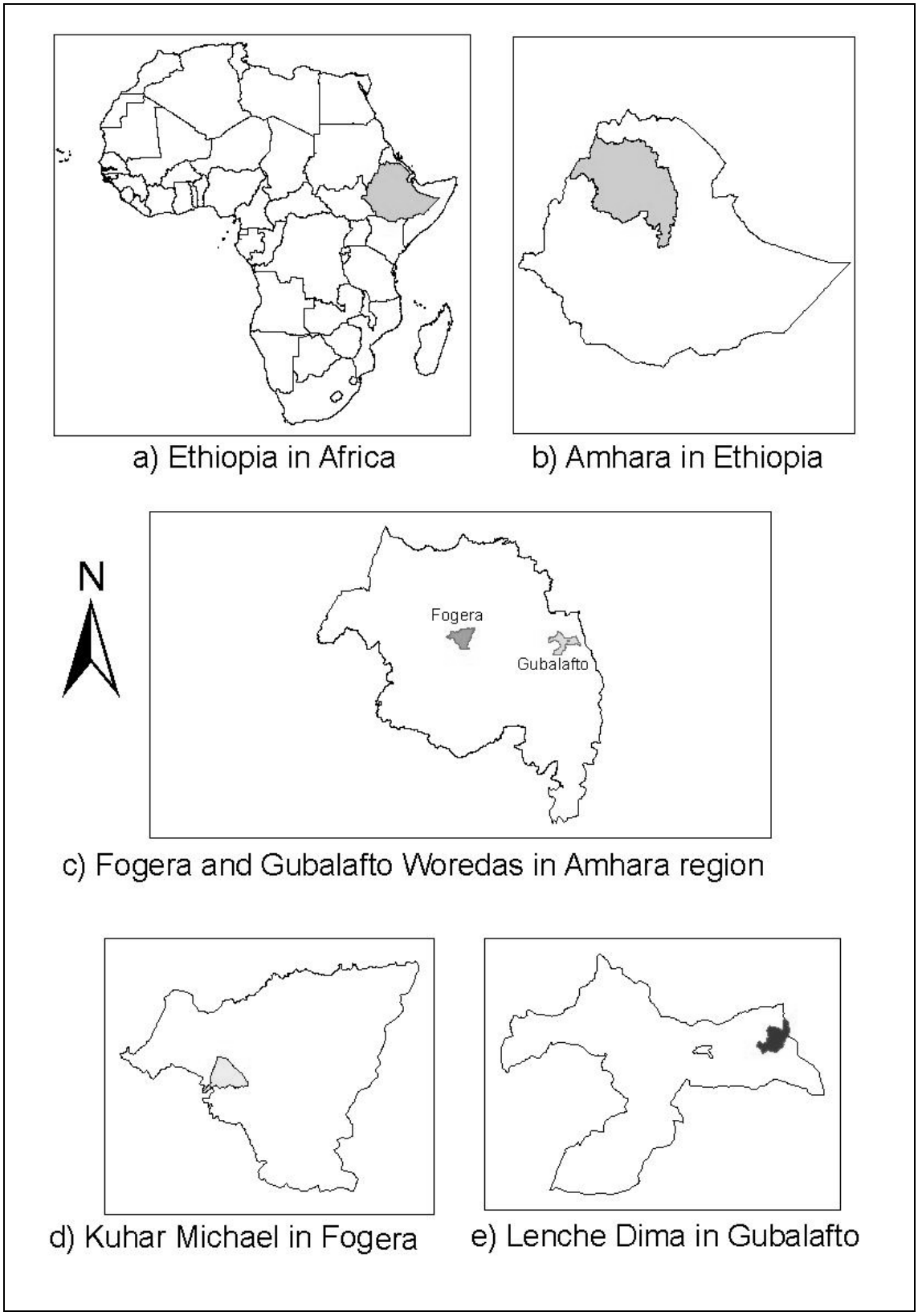


Figure 3.1 Location map of study sites in Amhara region, Ethiopia

The study sites were selected based on agro-ecology, accessibility, and the presence of different development interventions and institutional organizations. *Lenche Dima* and *Kuhar Michael* have different production system, agro-ecology and social structure (especially religion). The degree of water scarcity and land degradation also varies. *Lenche Dima* is a semi-arid/moisture-deficit and food-insecure area with mainly sorghum production entirely dominated by Muslims. In *Kuhar Michael* the two major crops produced are rice in the plain lands and millet in the uplands. The site is sub-humid/moisture-sufficient and food-secure and is dominated by orthodox Christians. Livestock is a very important asset in the farmers' livelihoods in both sites. However, productivity is low mainly due to feed and water shortage, disease and poor veterinary and extension services. Demographic and other basic characteristics are listed in Table 3.1 and 3.2.

Table 3.1 Demographic representations of the study sites

Population	**Amhara region (2008)**	**Fogera *Woreda* (2008)**	***Kuhar Michael* (2007)**	**Gubalafto *Woreda* (2008)**	***Lenche Dima* (Laste Gerado) (2004)**
Human					
Total households	-	42,746	1174	-	889
Male-headed HH	-	38,471	1061	-	619
Female-headed HH	-	13,138	113	-	270
Total	17,214,056	226,595	3673	139,800	3151
Males	8,636,875	115,693	1884	70,732	1723
Females	8,577,181	110,902	1789	69,068	1434
Urban: Males	1,024,136	12,339	-	2,377	-
Females	1,088,084	12,845	-	2,508	-
Rural: Males	7,612,739	103,354	-	68,355	-
Females	7,489,097	98,057	-	66,560	-
Livestock	**(2010)**	**(2008)**	**(2007)**	**(2008)**	**(2004)**
Cattle	12,746,768	168,785	3652	-	3210
Sheep	8,596,993	8,075	50	-	164
Goats	4,878,462	28,713	623	-	2072
Camels	34,649	-	-	-	110
Equines (Donkeys, mules, horses)	25,887,11	13,526	322	-	1010
Poultry	12,739,620	246,496	-	-	-
Bee colonies	822,336	21,883	785	-	-

Sources: CSA, 2010, CSA 2008, and development agents at the kebeles
Note: Some items in the table are missing due to unavailability of data; HH=households

The total human population is higher in *Kuhar Michael* than in *Lenche Dima* but density per hectare of land is higher in *Lenche Dima* (0.58 persons/ha) than in *Kuhar Michael* (0.43 persons/ha). Regarding livestock population, the number of cattle is higher in *Kuhar Michael* than in *Lenche Dima,* where there are more sheep, goats, and equines than in *Kuhar Michael*.

Table 3.2 Basic characteristics of the study sites

Characteristics	***Kuhar Michael*** **Plain land**	***Kuhar Michael*** **Upland**	***Lenche Dima*** **Watershed**
Topography	- Flat area with grass pasture	- Mountainous pasture land mixed with bush	- Flat land surrounded by many degraded hills
Farming system	- Rice-based farming system, cattle and sheep	- Millet-based farming system, cattle and goats	- Sorghum-based farming system, cattle and goats
Water access for crop and livestock	- Water sufficient - Better irrigation access	- Water sufficient - Limited irrigation access	- Water deficiency - Limited irrigation access
Major problems in general	- Water logging , pest and disease (human and Livestock)	- Exposed to soil erosion	- Drought, food insecurity; grazing land and water shortage
Livestock/water related problems	- Disease, flies; shortage of feed and clean water (during rainy season)	- Disease and shortage of feed and clean water (during rainy and dry seasons)	- Disease and shortage of feed and water especially during dry season
Major livestock- and water-related interventions	- Rice introduction - Irrigation - Area closure/pasture land - Urea treatment of crop residue especially rice - Animal production and fattening packages	- Inputs like improved seeds and fertilizer application - Animal production and fattening packages(to some extent)	- Integrated watershed management - Enclosure and hillside development - Food security safety-net program - Animal production and fattening extension packages

3.2 Data collection and management

The analysis is based on the data collected in three phases: June to December 2008, July to October 2009, and February 2010. During the first phase, transect walks with randomly selected members of the farmer communities were conducted. Based on their experience and knowledge, especially grazing areas and water sources were mapped with the help of social and resource mapping exercises. Other physical assets such as infrastructure were observed during the site visit. Following this, the randomly selected farmers conducted wealth ranking for the entire households in the villages (Figure 3.2). In light of this, the communities were grouped and characterized in four categories. Key informant interviews and group discussions (focused and non-focused groups) were also used to collect water- and livestock-related data.

In the second phase, July to October 2009, different PRA exercises were conducted with a total of 10 purposely selected target groups and 120 randomly selected individual farmers (Annex Table 5). A total of 151 other individuals also participated in different exercises. The PRA tools (Somash 1995, Chamber 1994) implemented were seasonal daily activity profiling, problem prioritization and farmers' animals preference ranking, matrix scoring (to determine gendered access to resources and benefits shared among household members), seasonal calendar for animal feed, water and labor availability, diseases and other related problems, crop calendar, impact diagramming for selected interventions (domestic water supply and water harvesting, small scale irrigation works, enclosures, and livestock extension package programs), participant profiling, and group discussions for several other livestock- and water-related issues.

Lastly, case studies of 18 purposely selected households with guiding questions were conducted in the third phase. To validate the data from the PRA exercises, secondary source (governmental and non-governmental institutions, cooperatives, associations, etc.) documents were collected mainly from the *woreda* sector offices and *kebele* development agents.

Throughout the course of data collection and analysis, the Gendered Sustainable Livelihood Framework (Figure 2.3) and Livestock Water Productivity Framework (Figure 2.2) components and strategies were used as guiding tools to collect data and depict results from outputs of the PRA exercises. MS Excel was used to compute quantitative data generated from participant profiling and secondary sources.

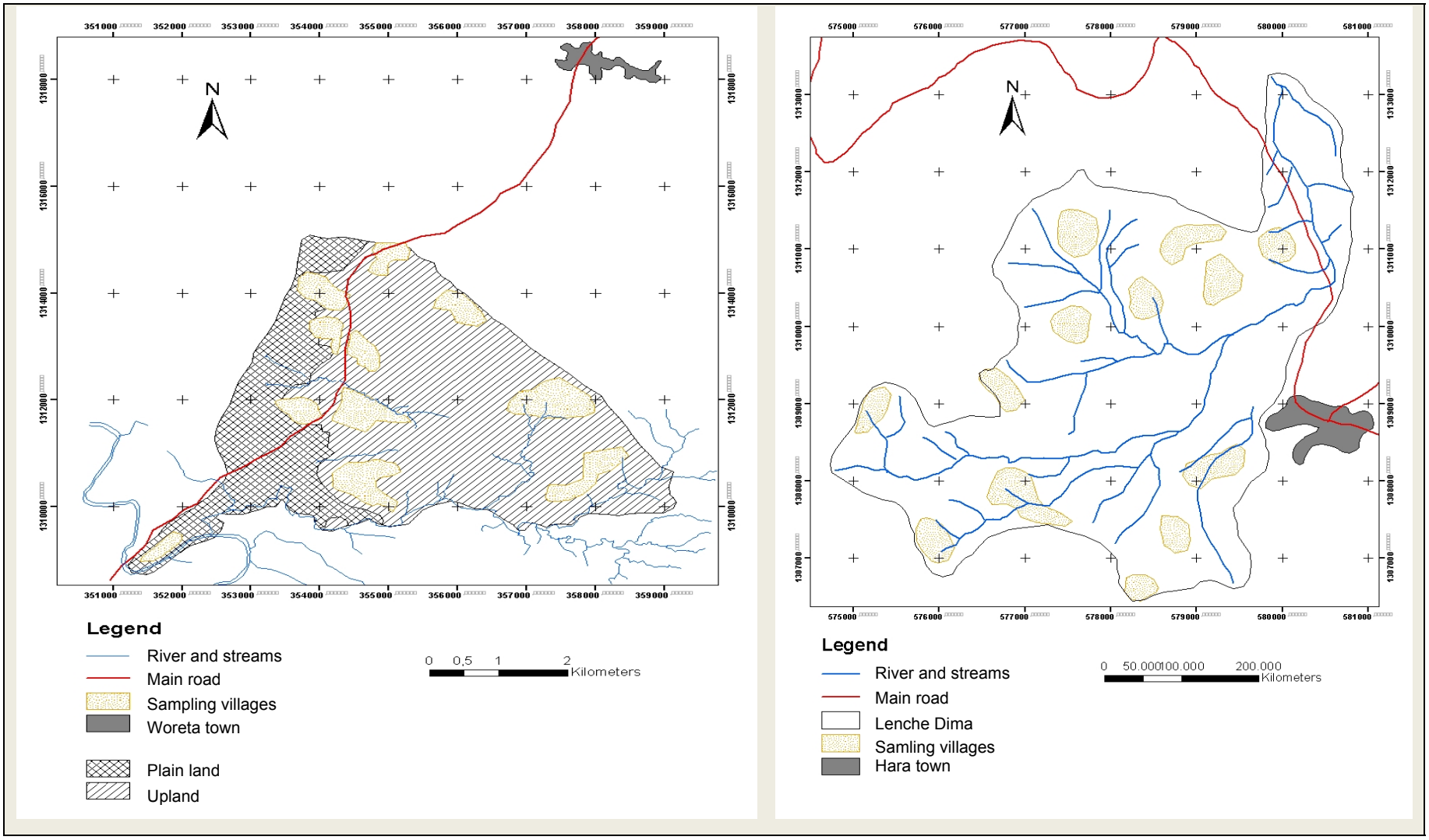


Figure 3.2 Map of the study sites including sampling villages, river and streams, nearby towns and land forms (*Kuhar Michael*)

3.3 Participatory rural appraisal (PRA)

Participatory rural appraisal (PRA) is a tool used to analyze local problems and formulate tentative solutions with local stakeholders. It enables people to express and analyze the realities of their lives and conditions, and to plan by themselves what to do. PRA makes use of a wide range of visualization methods for group-based analysis to deal with spatial and temporal aspects of social and environmental problems. Besides, the approach makes it possible to incorporate the knowledge and opinion of rural people in planning and management of development interventions.

PRA emerged from a range of methodologies including agro-ecosystems analysis and Rapid Rural Appraisal (RRA) in the 1970's and 80's, in which the emphasis was placed on finding ways to express the diversity of local knowledge through facilitation by outsiders. It evolved from two distinct traditions: planners seeking to overcome the limitations of externally dominated blueprint planning, and empowerment-oriented activists seeking to make their social transformation ideals more pragmatic. The approach is increasingly being used autonomously by communities. It is now becoming very diverse in its application, and hence can be considered as a single methodology (Chamber 1994).

It is important to note that the term PRA is somewhat misleading because the combination of techniques are equally applicable in urban and rural settings and are not limited to appraisal, i.e., they are also used for planning, monitoring and evaluation purposes. What makes PRA different from its origin (RRA) is that it emphasizes empowerment of local people through active participation, whereas RRA is merely a means for outsiders to gather information. The key elements of PRA are the methods used, and most importantly the behavior and attitudes of those who facilitate it. Accordingly, PRA provides a structure and many practical ideas to help stimulate local participation in the creation and sharing of new insights.

As PRA is not intended to collect statistically significant information, it is increasingly being used in combination with other methodologies to fulfill more scientific information needs and hence it is complementary. In this approach, there is no single way to 'do'. The PRA exercises which uses core principles and a range of methods available to guide teamwork, perform sampling, structured discussions and visualizes analysis. Optimal ignorance and triangulation of findings guide the fieldwork

in recognition of the need to know enough without knowing it all and to ensure that the qualitative insights are cross-checked by different sources using different methods (http://portals.wi.wur.nl/ppme/?Participatory_Rural_Appraisal_(PRA)). Thus, in this study of water livestock based livelihood analysis, PRA was used to implement the sustainable livelihood framework (SLF) including gender aspects. This is because the SLF is people centered, and PRA helps to gather all information in a participatory and holistic manner.

3.4 Target group differentiation and characterization

The rural poor are diverse groups with diversified livelihood systems and problems. Households often use their capabilities, skills, and know-how to diversify income sources and off-set risks (CARE USA 2002). It is apparent that those groups that have limitations to access assets and cope with stresses and shocks need to be given attention to improve their wellbeing status. Hence, identifying well defined, understood, and characterized target groups is of paramount importance for targeting interventions that fit with the needs of different categories. In this respect, there is a need to thoroughly conduct gender-sensitive analysis of poverty and rural livelihood situations. By doing so, it is possible to identify poor people and their livelihoods, their specific problems in relation to access to key resources that impact their production, food security, and income, the processes that cause poverty and the policy and institutional frameworks that exacerbate the situation.

Participatory poverty[10] and livelihood analysis can be used as a tool for targeting interventions and determining targets and the different activities to be undertaken (IFAD 2000). A livelihood assessment process involves several steps. In the beginning, vulnerable groups within geographic boundaries are identified based on agro-ecology or socio-economic conditions (CARE USA 2002: 9). Following this, the production system and different socio-economic categories of households is distinguished on the basis of wealth, main income source, and other criteria. The socio-economic category is further disaggregated by gender, age group and ability. Lastly, the

[10] Poverty here is defined as the condition in which a person or community is deprived of or lacks the essential livelihood assets for a minimum standard of wellbeing and living. The essentials might be material like natural assets (water, land, livestock etc.) or socio-economic-political resources (finance, wealth, services, mutual benefits, etc (http://en.wikipedia.org/wiki/poverty).

comparative differences in capacity and priority among these groups are distinguished. The purpose of going through these steps is to understand the livelihood dynamics of target groups. Hence, the underlying issues of poverty and equity are addressed through designing interventions based on priority needs (IFAD 2000).

According IFAD (2000) and MoARD (2006), the analysis and data collection process should start with focus group discussion with different stakeholders including development workers and key community representatives. What follows is the process of identifying the poor communities and conducting separate discussions with women and other marginalized/vulnerable groups. This exercise helps to understand the level of poverty among the groups on the one hand and their coping strategy on the other. Finally, individual experience of poverty needs to be explored through in-depth studies of poor households in order to avoid risk of misrepresentation of targets. Semi-structured interviews and/or informal meetings are helpful tools in this respect.

Regarding gender analysis, exploring gender relations and dynamics is critical to understand intra-household livelihood security. The analysis takes into account gender divisions of labor, access to goods and services, control over resources, power relations and rights. It also identifies strategies and activities that would contribute to improved gender equity. The potential for differential gender impact (both positive and negative) on a range of proposed intervention options should also be investigated, and finally, differences in class, ethnicity, age roles and responsibilities of women need to be dealt with.

As expounded at the beginning of this thesis, poverty and food insecurity are the major problems of the rural communities in the study sites. Their livelihood basically depends on a low-input/low-output rain fed mixed crop-livestock production system that impacts agricultural productivity and household wellbeing. Livestock is identified as a key resource that would improve livelihoods and equity through providing job opportunities, improved income, nutrition, and health, and gender-focused interventions. Despite the fact that livestock play an important role, its productivity is highly influenced by feed, water and disease problems. Water, which is a basic input in the livelihood activities of the rural poor, is becoming scarce partly due to livestock mismanagement. Consequently, improving livestock productivity in such water-scarce areas is a significant concern. This can be possibly done by integrated management of

water, crop, and livestock using different strategies (see Figure 2.5 and Annex Table 2). Targeting, which is the focus of this study, is a major tool for effective implementation of the proposed strategies to ensure gender-equitable poverty reduction. Therefore, this study explored the characteristics of the livelihoods' wellbeing/poverty status, and then identified and characterized target groups for the proposed general water productivity and LWP improvement interventions.

In the data collection process, wellbeing ranking of all households in the study areas was done to identify the level of poverty by gender as a basis for identifying target groups. Key informant[11] interviews and focused and unfocused group discussions including respondent profiling were also conducted to gather information for characterizing the different socioeconomic groups. Furthermore, impact assessment exercises were done with the different target groups in an effort to evaluate the impact of the previously introduced interventions. In depth discussions were held with men- and women-headed households and young poor farmers in order to gather information related to livestock and water and to explore their personal experience of poverty and their coping mechanisms. The findings from the different PRA exercises and the results of the other methods were used to further characterize and differentiate/refine the different groups to arrive at target groups that suit the strategies of the proposed LWP improvement program.

Generally, in the process of target group identification and characterization, the different socio-economic household groups were characterized based on the livelihoods' assets, activities, and outcomes. Since the poor households are of different types regarding problems, priority needs and coping mechanisms, the poor category was further characterized based on variables like livelihood assets and activities. In order to define the regional poverty differences between men and women, the characterization was disaggregated by gender and site. Finally, the typology of poor farmers was identified and divided into three basic groups: poor capable, young poor and very poor farmers for both men- and women-households that could be targeted for the LWP program. Based on the findings obtained, possible responsive interventions were forwarded accordingly (see section 6.1.1).

[11] Note informants include *woreda* experts and *kebele* DAs, local project representatives (IPMS and AMAREW), *kebele* administrations, organized farmer groups (farmers cooperatives, women groups under the cooperative) and other institutions/informal groups, irrigation committee members, elders and other community representatives.

3.5 Data/information collected and analyzed

The PRA exercises conducted, apart from identifying and characterizing the social status of different target groups, served as a source of information for identifying intervention options and targets that improve WP/LWP productivity and livelihoods.

To examine livestock and livelihood interactions and to identify the technical and strategic interventions required, a comparative analysis was made on livestock sub-systems and on the dynamics or shifts and their drivers in the livestock sub-system, and the implications these changes have on gender, livelihoods and problems in the system. Gender- and livelihood-related problems were identified and used for assessing and identifying solution options (interventions) and targets. The data collection process included: trend analysis; impact assessment of the previously introduced and currently proposed LWP interventions on livelihoods and gender equity, input/output (cost benefit) analysis of livestock keeping/LWP, and secondary sources analysis (section 6.1.2).

To examine the interaction of water and rural livelihoods and identify multiple-use options, three specific issues were discussed. These include the existing gendered Multiple Use System (MUS), the determinant factors (gaps) of MUS to improve Water Productivity (WP) in general and LWP in particular, and the entry points for promoting gender-sensitive interventions of WP/LWP programs.

In light of this, a comparative analysis was made for water resources, use and management, gendered governing processes, and gaps in the use system. Following this, impacts of the previous and current water development interventions (mainly domestic water supply, small-scale irrigation and water harvesting) on livelihoods and gender were assessed. Household case studies were also conducted to evaluate the MUS contribution and gaps in relation to livelihood improvement. Apart from the targeted single objective, the study examined the inclusion of livestock and other water-use services in the interventions, the contribution of local communities in the development of multiple-use service systems, and the possibilities to implement the system in place. The tools used were, resource mapping, water resource inventory spread sheets (Annex Table 7), impact assessment, group discussions, key informant interviews, and secondary source analysis (section 6.1.3).

Two other key issues were explored in order to determine livestock and water interaction at household level: the enabling and disabling conditions of different groups of poor households, and the responsive interventions and targets to invest in LWP improvement. Here, analysis of livestock ownership and its livelihood impact by gender and wealth groups, household analysis in terms of basic resources governance (access, control, and allocation) and interest and preferences of animal types and enterprise choice, gendered qualitative cost and benefit analysis of different animal types, and constraint analysis were made. Hence, the different problems and solution options/ technical interventions were identified as a basis for targeting the program (section 6.1.4). Finally, the key institutional and cultural aspects of LWP improvement processes were discussed (see section 6.1.5) followed by further analysis and interpretation of the findings in relation to government policy, development interventions, and household responses to invest in LWP programs for livelihoods improvement.

4 COMPARATIVE DESCRIPTION OF STUDY SITES

4.1 Environments and agricultural/livestock potential

In this section, the comparative features of the study sites with respect to environmental conditions in general and the potential for agriculture and livestock production in particular are discussed.

4.1.1 Environmental features

Lenche Dima is a watershed with an area of 1,546 ha. It is located in a semi-arid (altitude <1500 m.a.s.l.) mountainous area of northern Ethiopia, which is severely degraded. It has relatively low, unreliable and bimodal rainfall with an annual average of 667 mm. The rainfall is unevenly distributed in both spatial and temporal terms. The water supply is insufficient during most of the year. The climate is hot and characterized by '*kola*' (lowland) agro-ecology with temperatures ranging from 20 to 28°C (McHugh 2006).

The population density is about 218 persons per km^2 area, and a significant number of people in this area depend on food aid. This is because it is a food-insecure area with average land holdings of 0.75 ha per household, where sorghum-based dry land agriculture is practiced. The area is known for its crop and livestock production and draft power is the main livestock output (AMAREW 2006). *Lenche Dima*'s landscape 33 % is covered by steep hills and mountains, while the remaining consists of 35 % valley bottoms, 6 % of upper foot slopes, 18 % of lower foot slopes, and about 3% are bottom flat areas (Gizaw et al. 1999).

The farming system in *Lenche Dima* is mainly rain fed subsistence mixed farming with little or no cash crops. The use of modern agricultural inputs is very limited. The *belg*[12] rain is usually insufficient for cropping, but is beneficial for pasture re-growth after the long dry period. As the main rainy season is variable and often short, farmers grow drought-resistant crops like sorghum (see section 4.1.2).

Kuhar Michael is a peasant association or *kebele* with a total area of 2755 ha and altitudes ranging from 1792 to 1959 m.a.s.l. The area is moisture surplus with an annual average rainfall of 1200 to 1400 mm. The rainfall is uni-modal (June to

[12] *Belg* rain or little rain is a short and moderate spring rain in March and April following the long dry period, which is raining in some lowland and dry areas of Ethiopia (http://vf-tropi.com/vf-defs html).

September/October). With temperatures ranging from 19 to 21^{o}C, the climate is moderate (Descheemaeker 2008: 20). According to the land-use information obtained from the *kebele* DAs, cultivated land covers 1814 ha, grazing land accounts for about 513 ha, forest coverage is about 418 ha, and non-cultivated land and buildings cover 5 ha each. The landscape is characterized by of mountainous (68 %), plain lands (28%) and hilly areas (4 %).

The agricultural production system is mixed livestock that is dominated by cereal crops. The major crops include rice, which is cultivated in the plain areas (plain land), and millet and teff in the mountainous areas. Farmers also grow vegetables crops, particularly onions and tomatoes, during the dry season using both modern and traditional irrigation from different water sources (rivers, wetlands, streams, ponds and hand-dug shallow wells). A few farmers are also engaged in seasonal fishing from the River Gumara as all off-farm activity.

The plain land is annually affected by seasonal flooding due to overflowing of Lake Tana and the Guanta and Gumara rivers. Though much of this area is used for livestock grazing during the dry season, animals are vulnerable to diseases and biting flies due to the effects of the flood (IPMS 2005). Furthermore, the seasonal flooding has made the area favorable for insect breeding with the consequent risk of malaria epidemics. Besides, the high level of surface water makes the drinking water unsafe, which in turn contributes to the spread of other water-borne/related infectious diseases.

The spatial rainfall distribution in the two study sites and flood risk/hazard spatial coverage of *Kuhar Michael* are shown in Figure 4.1 and 4.2.

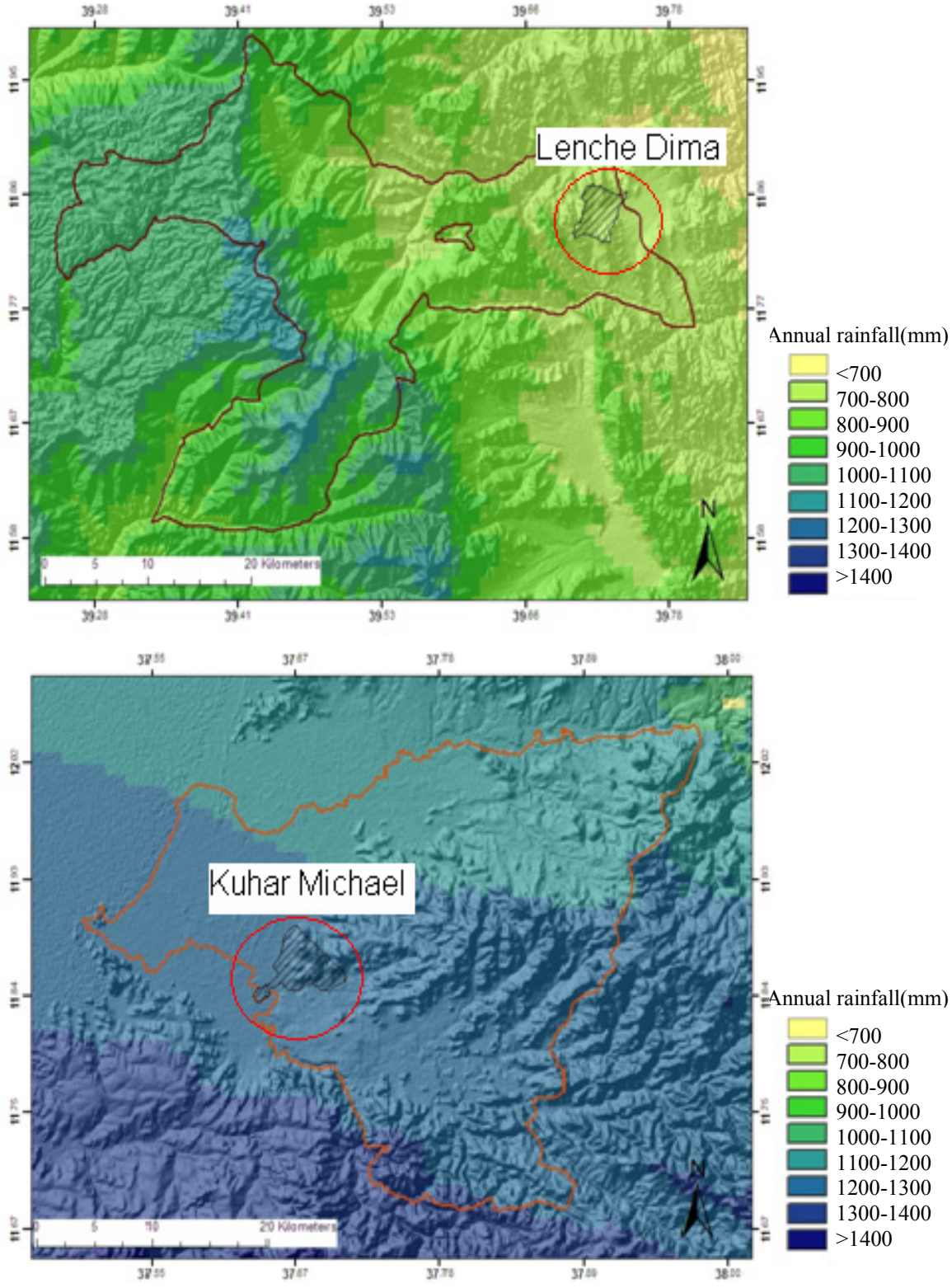


Figure 4.1 Annual rainfalls in *Gubalafto woreda*, *Lenche Dima* (the upper) and *Fogera woreda, Kuhar Michael* (the lower) (*Source*: Descheemaeker 2008: p. 19)

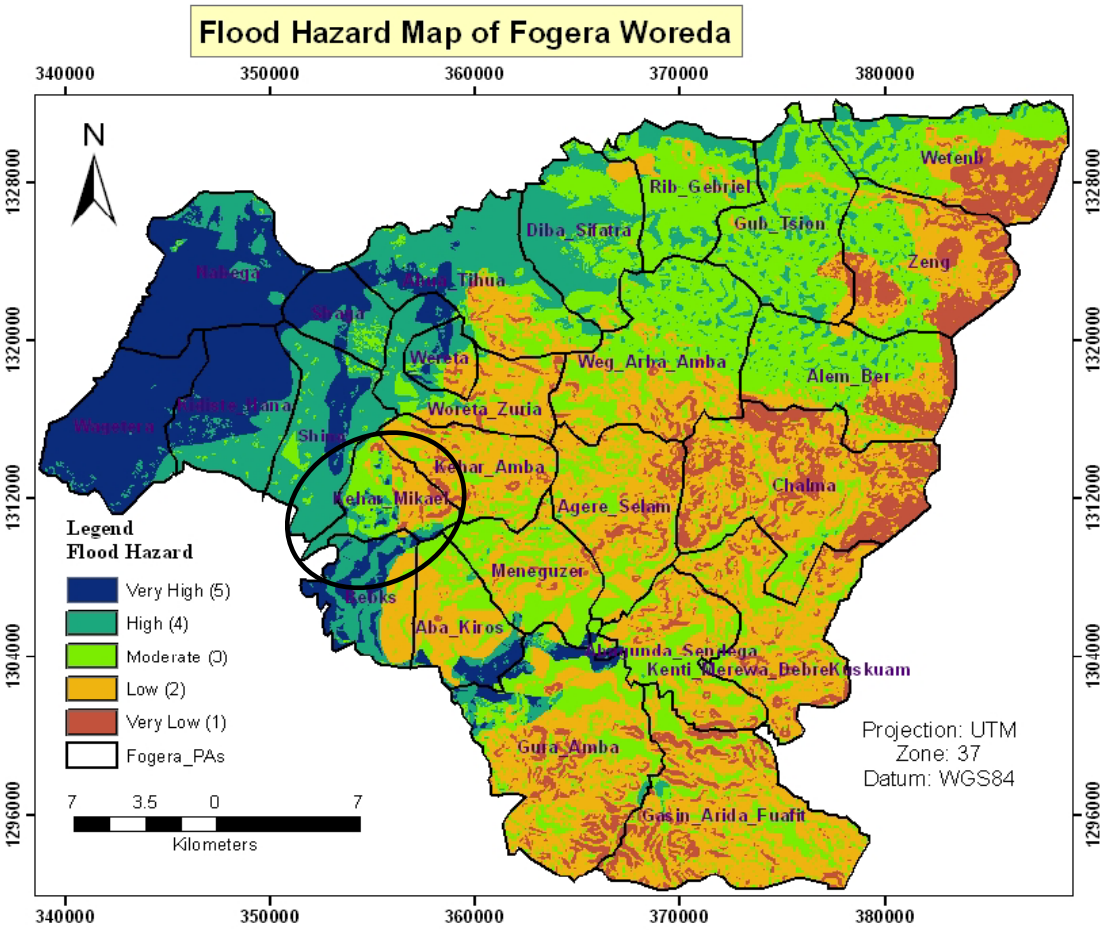


Figure 4.2 Flood hazard map of *Kuhar Michael* (circled) in *Fogera woreda* (Source: Woubet 2007: p. 63)

According to Woubet (2007: 63-64), from total area of 2755 ha, about 2160 ha (21.6 km^2) of land in *Kuhar Michael* is vulnerable to flood hazard, and the *kebele* is moderately vulnerable in general.

4.1.2 Agricultural/livestock potential: productivity and impacts

The production systems in both study sites consist of crop production and animal rearing activities. The benefits obtained from animals in these areas are manifold. Cattle, for instance provide labor power for plowing and threshing while donkeys and camels are used for transporting farm inputs and outputs. Animals also serve as a source of income to buy other inputs like inorganic fertilizer, pesticides, and herbicides. In addition, the manure obtained from different animals is also used for soil fertility improvement in the crop production process. Crop residues and other green feedstuffs from the farmland are used as major animal feed sources.

However, the two sites are different with respect to the type and composition / proportion of crops, livestock, and time of growing crops, and availability and accessibility of different inputs such as water, animal feed and labor (Tables 4.1, 4.2 and 4.3).

Table 4.1 Production systems in *Lenche Dima* and *Kuhar Michael (*computed from information obtained from DAs and Key farmer informants)

Variable Indicators	***Lenche Dima***	***Kuhar Michael***
Basic crop types	- Sorghum, teff and chick pea - Irrigation-based maize and vegetables (onion and pepper)	- Rice (plain land), millet (upland), chick pea, rough pea, and lentil - Irrigation-based maize and vegetables (onion and tomato)
Other crops	- Sesame, flux, noug, pea and wet season pepper	- Teff, noug, wet season pepper, potato, barley and wheat
High labor-demand months	- August for weeding - October and November for harvesting and collecting crop residue and storing on farmland[a]	- July and August for weeding - September to December for harvesting and collecting and carrying crop residue to residence
Livestock types	-Cattle, goats, sheep, donkeys, camels, chickens and bees (all traditional hives)	- Cattle, goats, sheep, donkeys, chickens and bees (traditional hives and a few modern ones)
Animal feed source	- Crop residue mainly from sorghum, farmland green feeds, open road-side and common grazing areas, crop aftermath, enclosed hills, etc.	- Communal and open grazing lands, crop residues, crop aftermath, farm land green feeds and private grazing land

[a] *Labor is not required to carry residue except at time of need since crop residue is left on the farmland.*

Seasonality and diversification of crop and animal feed sources are relatively better in *Kuhar Michael* as compared to *Lenche Dima* (Table 4.1). As a result, crop and farm residues are available for all extended period of time. This implies that the area is a relatively better environment for agriculture and livestock production. The availability of open grazing land is also another potential for livestock keeping provided that grazing management, improved health services, markets, and other related inputs are made available. On the other hand, due to various labor-intensive farming activities

(Table 4.2 and 4.3), the demand for labor is high for about six months. Consequently, during these periods there is acute shortage of labor for livestock productivity improvement, especially for labor constrained households. In a nut shell, agricultural potential is lower in *Lenche Dima* as compared to *Kuhar Michael* (AMAREW 2007: 14).

Table 4.2 a Seasonal crop production activities and labor calendar for *Lenche Dima*

Crop types grown in order of priority	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**
Sorghum: *Dogalit* (slow growing variety)	W	-	½ H	½ H	-	P	P	S	S	-	T	W
Sorghum: *Jigurty* (fast growing variety)	W	-	½ H	½ H	-	-	-	P	P	S	S	W and T
Teff: *Bunign*	½ H	H	TH	-	-	P	P	P	P	P	S	W
Teff: *Tikureta*	-	H	TH	-	-	P	P	P	P	P	S	W
Teff: *Magna*	-	½ H	½ H	TH	-	P	P	P	P	P	S	W
Chick pea	½ W	½ W	½ H	½ H	-	P	P	P	P	-	-	½ S
Maize in back yard	½ H	½ H	-	-	-	-	-	-	-	P	S	W
Sesame and sorghum	-	Late H	H	-	-	P	P	S	S	-	-	-
Flux, sorghum and teff	-	H	-	-	-	-	-	-	-	S	S	-
Noug, sorghum and teff	-	Late H	½ H	-	-	P	P	P	P	-	S	-
Field pea	H	H	-	-	-	-	-	-	-	P	S	W
Pepper	-	Late H	-	-	-	-	P	P	P	P	S/PL	Ho
Maize (irrigated)	-	-	-	-	-	P	S	W	W	H	-	-
Pepper (irrigated)	-	-	-	-	-	PL	-	Ho	Ho	H	-	-
Onion (irrigated)	-	-	-	-	-	PL	-	Ho	-	H	-	-

Note: *W=Weeding, H=Harvesting, S=Sowing, P=Plowing, T=Thinning, Ho= Hoeing, PL=Planting, 1/2=half of the month, Late refers to the end of the month*

Table 4.1 b Scientific names for major crops growing in the study sites

English name	**Scientific name**	**Amharic name**
Teff	*eragrostis tef*	Teff
Rice	*oryza sativa (NERICA species)*	Russ
Finger Millet	*eleusine coracana*	Dagusa
Sorghum	*sorghum bicolar*	Mashila
Maize	*zea mays*	Bokolo
Wheat	*triticum aestivum*	Sinde
Niger seed	*guizotia abyssinica*	Noug

Table 4.3 Seasonal crop production activities and labor calendar for *Kuhar Michael*

Months	Major activities	Labor demand	Labor management	Remark
Sep	Tomato planting, teff harvesting, and sowing of wheat and/or pulses	High	Use own family labor, may hire 1 or 2 daily laborers; also collective work arrangements of human and animal labor	Laborers are involved in harvesting and crop residue collection
Oct	Millet and rice harvesting, and sawing of rough pea/chickpea	High		
Nov	Plowing and onion planting	High		
Dec	Rice threshing and onion planting	High		
Jan	Millet and rice threshing and onion planting	Shared	Use own family labor or arrange sharing, collective work or exchange labor especially for plowing	
Feb	Millet threshing and onion planting	Shared		
Mar	Plowing, pulses harvesting and threshing	Family		
Apr	Plowing and land preparation	Family		
May	Sawing of millet, maize, barley, tomato and noug	Family		
June	Sowing of rice and pepper, weeding	Family		
July	Teff and rice weeding, and tomato seedling preparation	Very high	3-4 laborers are hired, since weeding is labor intensive	Rice weeding 2 or 3 times
Aug	Rice weeding and tomato seedling preparation	Very high		

Urbanization has contributed to livestock development since the demand for livestock products has increased on the one hand and infrastructure has improved on the other. Moreover, farmers these days use alternative feed sources like crop and farm residues and purchase feed due to the dwindling of grazing resources. This is would further improve livestock water productivity thus minimize grazing land degradation, which is caused by overgrazing and soil compaction.

4.1.3 Water regimes

The water regime in Ethiopia is different from place to place and is strongly affected by climate change. The water regime in the study sites was comparatively seen. In the study sites, water is obtained from three major sources (rainfall, surface, and ground-

water) for both domestic use and productive purposes. Due to various driving factors, water availability and accessibility varies between the sites and among villages, gender and other social groups and seasons. Agro-ecology, topography, seasonality, infrastructure, institution, and socio-economic, conditions are the major factors contributing the variation (see Table 6.12 section 6.1.3).

In *Lenche Dima*, water for domestic use is accessible through piped water from deep well (groundwater) in both the dry and wet seasons. Besides, excavated and natural ponds, permanent rivers, and wetlands serve as dry-season sources. Though not effective due to design and construction constraints, runoff-water-harvesting technology was also implemented by some 20 farmers as a dry season water source. To some extent, wealthy farmers use the piped water[13] for their livestock during the dry season while others use distant water sources. However, dry-season livestock water shortage is still a major problem in *Lenche Dima*, especially from November onwards (in bad years) and become worse in May and June (Figure 4.3). Women and children (especially girls) are responsible for collecting water for both domestic use and homestead livestock watering (Figure 4.4).

In *Kuhar Michael*, farmers use different water sources for multiple uses. Mostly, rivers are used for livestock watering and irrigation. Other sources include open and shallow communal wells, natural ponds, streams, rivers and rain-water. Some households have access to a clean water supply from the recently introduced systems. Others have private hand-dug shallow wells (rope and bucket system) used for multiple purposes (domestic use, livestock watering and gardening).

Water availability is relatively improving as compared to the past, women, girls and men (in extreme cases) for instance, use to have to travel long distances to fetch water. The situation has improved due to water development interventions in some localities. These include domestic water supplies from deep well (hand pumped or piped) and cylinders (cemented shallow well with rope and bucket system), irrigation canal development, and spring water enhancement and river diversion works.

[13] Water is obtained from the domestic water supply system introduced by a NGO-supported water development project. Users pay 20 cents per 20 liter of water, which is equivalent to= USD 0.012.

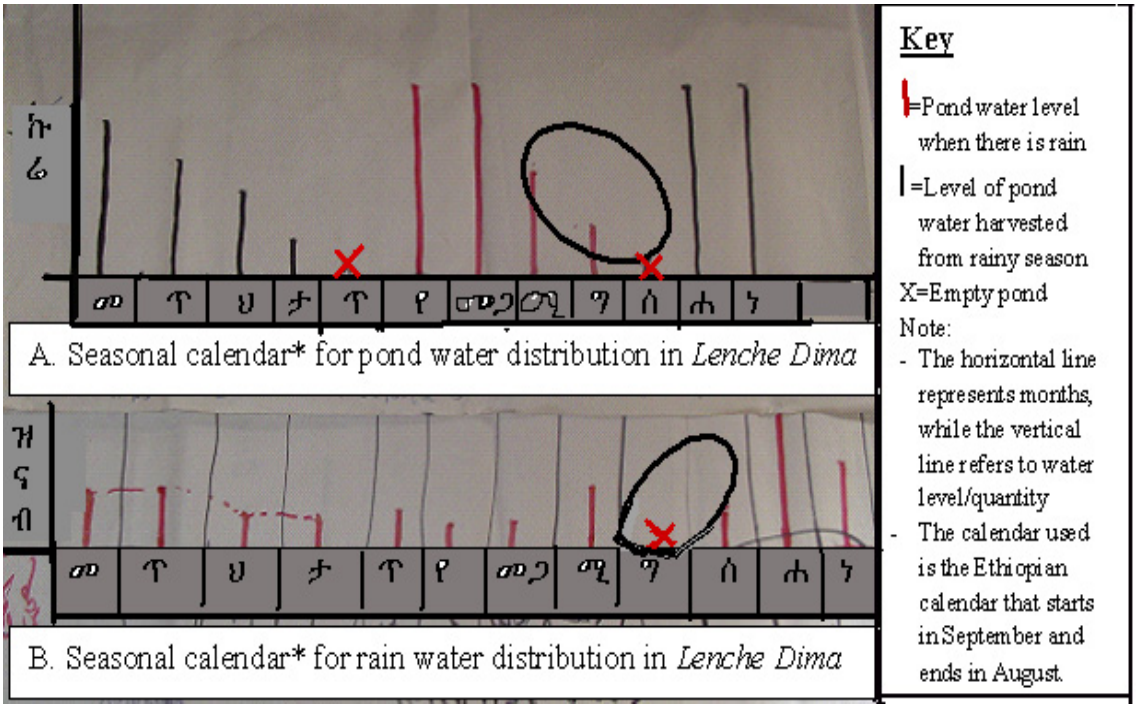


Figure 4.3 Farmers calendar for seasonal water distribution in *Lenche Dima* (Picture from seasonal calendar exercise, 2008).

Notwithstanding the various efforts made, the problem still persists. In *Kuhar Michael,* for instance, flood is a critical challenge in the plain land especially during the rainy season, and affects quality water availability for both human and livestock use. Furthermore, the hand-dug shallow wells easily collapse during heavy rain due to the shallow water table and fragile nature of the soil, which needs constant attention in order to improve the service life of these structures.

Figure 4.4 Women and children in collecting water in the study sites, *Lenche Dima* (the left) and *Kuhar Micahel* (the right) (Picture taken in 2008).

Most farmer households have water shortage problems during the dry season, particularly due to failure of the natural sources like rainfall, rivers and wet-lands. The water availability is limited when precipitation becomes low, the rivers, ponds, wetlands, and other water storage pools become dry, and the public water supply system fails. Shortage of fuel in *Lenche Dima* (for pumping water), structural failure, poor maintenance of hand pump structures and collapsing of hand-dug shallow wells in *Kuhar Michael* are some of the factors that lead to the water supply failure. The problem of water scarcity is relatively more serious in *Lenche Dima* than in *Kuhar Michael* in connection with agricultural practices in general and livestock productivity in particular.

Farmers in these areas are now trying to cope with this challenge, by changing their water collection practices. These include switching to other distant water sources, collecting water from rivers and small pits adjacent to/in the water ways of dried rivers (Figure 4.5), buying water from deep and shallow wells governmental in *Lenche Dima;* or private in *Kuhar Michael* and sharing water with neighbors. In addition, more household members are involved in water collecting, especially water from distant sources, and farmers are trying to use water more economically by prioritizing activities such as drinking and cooking.

Figure 4.5 Collection of water from dried river in *Lenche Dima*) (Picture taken in 2008)

4.2 Livelihoods systems and cultural settings

The livelihood system, cultural settings as well as the societal and political endeavors and related impacts are major concerns discussed here.

The basis of the communities' livelihoods in both study areas is agriculture in which animals play a significant role by providing power for traction, threshing and transporting agricultural inputs and outputs. As stated earlier, the type of crops produced, their market value and productivity per unit of land are different in the two areas due to the agro-ecological and topographical conditions. This in turn influences food and income level of the communities.

The types and contributions of livestock are also slightly different in the two areas. In *Kuhar Michael*, for instance, animals are used as a source of food milk, meat, and eggs and income from sale of live animals. In *Lenche Dima*, farmers do not have income from animal products due to low productivity and the prevailing taboo that prohibits selling animal products particularly milk. Hence, there is a need to improve animal productivity and to address socio-cultural issues in order to enhance the contribution of livestock keeping to the wellbeing of the communities.

The social structure of the two sites is quite different, which is manifested in religion; *Lenche Dima* is dominated by Muslims, while most of the communities in *Kuhar Michael* are of orthodox Christians. Religion has its own institutions, cultures, and customs that in turn positively and negatively impact their contributions and participation in development and livelihood improvement activities. Christian women in the men-headed households, for instance, are not allowed to freely participate in productive activities and community organizations.

The most important livelihood assets, in order of priority include water, land, labor, and livestock. These are also used as the major criteria for farmers' wellbeing classification. The farmer communities are classified in four distinct categories of wellbeing status: ***better-off, medium level, poor capable, and poor of poor***.

Better-off refers to households that possess more than 2ha land, more than one pair of oxen, additional livestock like cows, sheep and goats, donkeys, camels, a mule, and bee hives. Farmers of this category have the potential to produce enough food to meet the demand of their family throughout the year; generate extra cash to cover other expenses, medication for instance; and invest on assets like water pumping motor for irrigation and private water structures. Relatively speaking, they enjoy better housing, nutrition, clothing, education, etc.

Medium level farmers are those with land 1-2 ha land, single or pair of oxen and enough labor. These farmers can produce and feed their families for at least 6 to 9 months in a year, and some of them have extra livestock.

Poor capable represents those households that possess 0.5-1ha land, no or only one ox, and insufficient agricultural labor. They are not in a position to produce and feed their families even for 6 months in a year. Some of them rent out their land to others, while others are engaged in non-agricultural activities like selling fire wood, locally produced alcohol, especially women farmers, and small-scale trade. Family members of this group work as daily laborer on some occasions.

Poor of poor comprises those households who are either old-aged or too weak to undertake any income generating activity, especially agriculture. They are entirely dependent on relatives, communities or the government aid for their livelihoods (see section 6.1.1).

As indicated earlier, livelihoods problems, causes and effects are different between the study sites. The level and causes of poverty, one of the major problems, varies regionally. In *Lenche Dima*, for instance, the root causes are climatic factors (recurrent drought) and resource limitations (land, labor and draft power). The major problems related to livestock keeping in order of importance are shortage of feed, water supply problems and diseases.

Coping mechanisms also vary between sites. However, farmers commonly apply major strategies including: land renting (for 1 to 25 years), sharing of land, labor, other inputs and outputs, support from relatives and communities, credits/loans from government and better-off individuals, food security and safety-net programs, and migration for off-farm jobs.

4.3 Societal and political endeavors and related impacts

As rural poverty and environmental degradation are standstill problems in Ethiopia, they are major development agendas often involving different stakeholders. In order to alleviate these problems, policies and strategies of agricultural development and natural resource management were formulated and implemented along with various poverty reduction measures. As a result of collaborated efforts of the governmental and nongovernmental institutions with the community, significant changes have been

registered in resource management, agricultural productivity, and livelihoods improvement.

Benin et al. (2003: abstract) in his livestock policy discussion paper, for instance stated that "*since 1991, there have been significant changes in utilization of feed resources in the Ethiopian highlands. Use of communal grazing lands and private pastures has declined; use of crop residues and purchased feed has increased. In addition, although use of animal health services and adoption of improved livestock breeds and modern management practices have increased, ownership of various types of livestock has declined. Rapid population growth has contributed most to the declining trends in grazing resources and ownership of livestock, showing the negative effects of increasing pressure on already degraded resources in the Ethiopian highlands. Land redistribution, increased participation in credit and extension programs targeting livestock, and improvement in access to markets, on the other hand, have had significant positive impacts on adoption of improved livestock technologies and ownership of livestock. Thus, reducing population growth and improving access to markets and credit and extension programs targeting livestock can enhance the role of livestock in improving food security and reducing poverty, especially in the mixed crop-livestock farming systems*".

Similarly, in the study sites, the various societal actions and government policy decisions have brought significant changes in the livestock system. Shifts in the feeding system, feed sourcing and grazing land use, multiple use of livestock keeping, and farmers' behavior and attitude have changed with respect to resource dynamics like land and water are the major changes. These changes have an impact on productivity, livelihoods and gender equity as discussed in the following.

To begin with, the change in the animal feeding system refers to the shift from free grazing to controlled grazing and stall feeding. The land redistribution policy and the cultural practice of land division (especially through marriage), which reduced the size of the land holdings, have contributed to this change (Owen et al. 2005: 440). This saves time and energy that can be used for other productive activities. However, the stall feeding system creates all additional workload for women.

The shift of animal feeding from open free grazing land to private grazing land (*Kuhar Michael*), enclosures (*Lenche Dima*) and purchased feed is the change with

respect to feed source. The feed type has also changed from natural pasture to crop residues, other farm residuals and fodder. This is caused by weak societal grazing land management. The shift mainly helps to protect the environment, enhance resource conservation, and improve technology transfer/uptake possibilities and decision-making capability. The dependency on crop residues on the other hand might be a challenge for those farmers that rent out land and also opportunities for those farmers renting the land.

There is also a shift in the purpose of keeping animals from production for home consumption to market sale. Seasonal fattening/conditioning of camels in *Lenche Dima* and small animals in both sites, for instance, are part of these changes that can help to minimize risks and mitigate climate change. The opportunity of market access and the increased market value of animals due to government actions like urbanization have contributed to the change.

Lastly, the changes in farmers' behavior and the attitudes refer to the change in valuing their animals. These have led to, for instance, leaving a part of the farmland for grazing (in *Kuhar Michael*), collecting and storing crop and other farm residues for animal feed and purchasing of supplemental feed.

In the process of these changes, the role of political influence is critical and includes area enclosure on degraded grazing lands, land including redistribution of communal grazing lands, and credit facilitation for poor farmers to motivate them to engage in livestock keeping. However, competition and conflicts over common resources that resulted in degradation and resource depletion (mainly grazing land and water) are the major societal push for change.

4.4 Climate change

4.4.1 Overview

Climate change is a global problem, though its consequences vary from place to place. It more strongly impacts developing countries than developed. Flooded basements, for instance, are a major problem in Northern Europe. While changing rainfall patterns and temperature increases may mean the difference between life and death in Ethiopia. Developing countries have neither the resources nor the capacity to adapt to the changed climate (Malene 2009: 14-15).

The poor people living in the least developed countries are typically the most vulnerable to climate change due to the ever-increasing weather related disasters (flooding, drought, storms, and environmental degradation). Ethiopia is in the list of the ten most socially and economically vulnerable countries in the world (IPCC 2007). Small holder and subsistence farmers, pastoralists, and artisanal fisher folk are exposed to the complex and localized impacts of climate change, owing to constrained adaptive capacity.

Unusual rainfall, hot summers and extraordinary floods are some of the indicators of climate change due to global warming. Climate change is a phenomenon that gradually occurs as a result of the combination of rapidly rising temperatures and the rising levels of the greenhouse gas carbon dioxide (CO_2) in the atmosphere. Industrialization, deforestation, and poor agricultural practices (especially free livestock grazing) are responsible for rise in CO_2 emissions and aggravate climate change.

The increasing occurrence of droughts and floods will affect crop and livestock productivity and will have adverse impacts on food/feed security. This is true particularly in the areas where farmers' consumption mainly depends on agriculture in countries like Ethiopia (IPCC 2007: 32-33). In Ethiopia, repeated droughts, hunger and the recent floods are among the most climate change serious problems affecting millions of people almost every year.

Climate change not only affects agricultural productivity in Ethiopia, it also leads to the occurrence of different diseases such as malaria and cholera and to malnutrition. It also has an impact on the ecosystems on which many people depend for their livelihoods, e.g., natural resources such as fertile land, communal grazing areas and water and can lead to conflicts over resources. Particularly, it aggravates water shortage. Countries like Ethiopia, which depend on water for their electric power generation (accounts for 98 % of the country's electricity power source), are highly vulnerable to climate change due to insufficient rainfall. Thus, the country's economy is affected by low productivity of both agriculture and industry (IPCC 2007: 32-33).

A study by Tröger et al. (2011: 10-11 www.hoarec.org/index.php/publications) shows the two types of climate change patterns in Ethiopia. On the western side of the country, the impact of climate change is expressed by irregular and unpredictable rainfall over a short period of time, increase in frosts or hailstorms, and increased

temperatures. The eastern side, on the other hand, mainly suffers from shortage or absence of *belg* rainfalls for 3 to 5 years, as the wind from the Indian Ocean is diverted due to the climate change effect before reaching eastern Africa. Since the people in the east greatly depend on *belg* rainfalls for agriculture, climate change has a strong impact on livelihood security. Farmers experience these changes and observe changes in rainfall patterns, temperatures, surface water availability, and occurrence of uncommon human and animal diseases (Temesgen et al. 2009: 249). This applies to the study sites, where *Lenche Dima* lies in the eastern side and *Kuhar Michael* in the western side.

4.4.2 Climate change and livestock

On the one hand the impacts of climate change on livestock are reflected in feeds and water, livestock diseases and disease vectors (Thornton et al. 2008a). On the other hand, agriculture, especially livestock, contributes climate change through methane and carbon dioxide emissions that increase the level of greenhouse gases. Of the total anthropogenic/human-induced greenhouse gas emissions, 18% comes from livestock activities (Thornton and Herrero 2010: 50-53; van de Steeg et al. 2009: 19-21).

Adaptation and mitigation are the two major response strategies to climate change. In this connection, livestock can play an important role through better livestock management especially by introducing production practices that can reduce livestock-related greenhouse gas emissions. These include using more nutritious pasture grasses, restoring and rehabilitating degraded grazing lands, using crop residues and other farm residuals instead of grazing, planting forage trees to supplement animal diets, and using other intensification and income diversification strategies (Thornton and Herrero 2010: 60 - 63).

5 LIVESTOCK HUSBANDRY

5.1 Requirements of livestock keeping

Livestock husbandry is mainly concerned with keeping livestock well-fed and healthy so that they better serve the best interest of the owners with the available resources. It is comprised of different interacting components including nutrition (feeding and watering), health, breeding, housing, animal welfare, etc (Figure 5.1). While planning any livestock development program, these components, along with respective activities need to be assessed in an integrated manner.

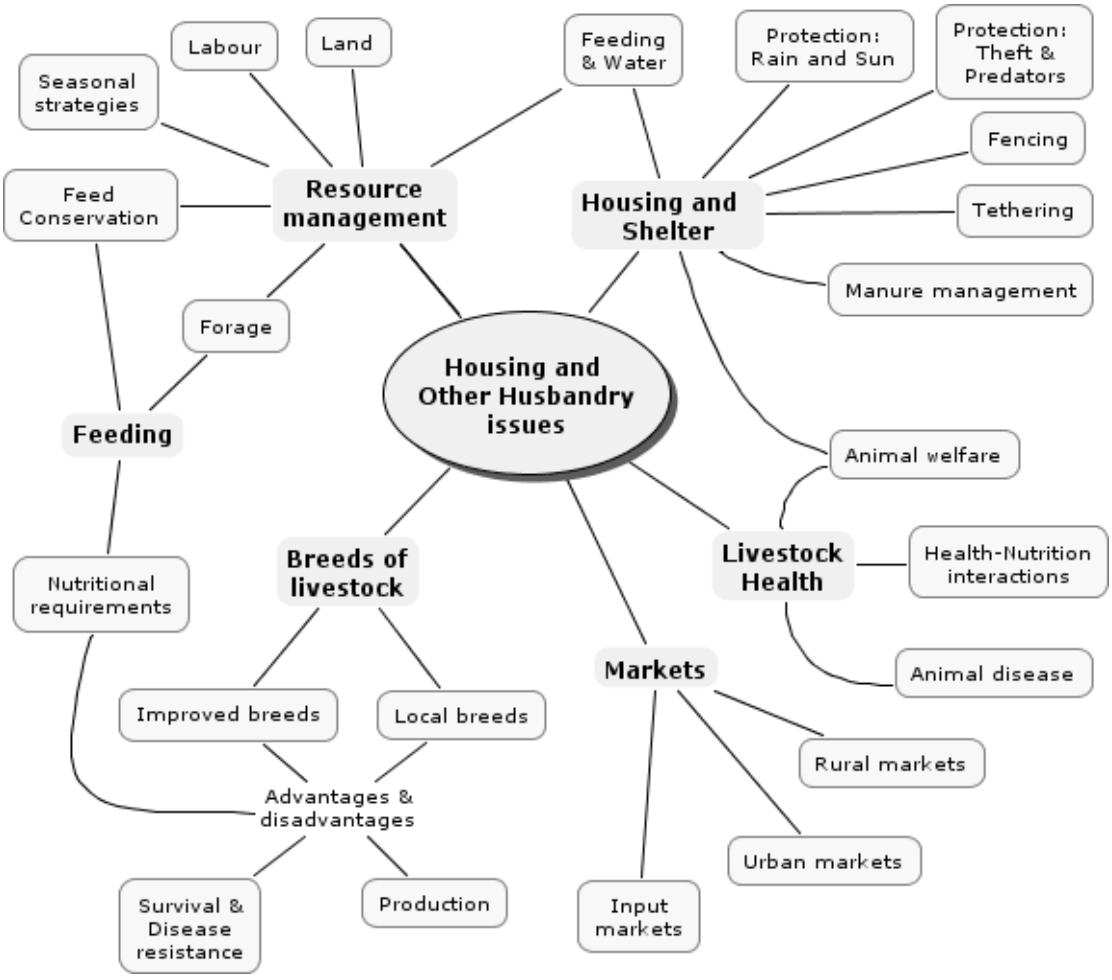


Figure 5.1 Major components and activities required in general animal husbandry (Source: DFID 2006 at http://www.smallstock.info/info/genhusb.htm)

There are clear and strong interactions among the different parts of the animal production system; a change in one part will affect the others as well as the general animal productivity. Some of the interactions are as follows (DFID 2006).

1. *Feed and veterinary services interaction*: Notwithstanding the fact that well-fed animals have better resistance to the effects of parasites and diseases than poorly-fed ones, the need for veterinary treatment is inevitable during severe and possibly fatal disease. Hence, vaccination coupled with proper feeding and housing can protect the animals from diseases.
2. *Breed interaction with feed, veterinary services and housing*: Genetically high-potential animals produce more than poorly breeding animals provided that feed, disease control, housing, and other conditions are sufficiently fulfilled. But in the situation where one of these factors is unsatisfactory, high potential animals may easily lose their resistance, while the poorly-breeding animals remain relatively strong and can survive.
3. *Housing interaction with hygiene and health*: The provision of good housing can improve the productivity of livestock by giving protection from environmental stress and predators. However, absence of appropriate /sufficient hygiene can lead to higher incidence of parasites and diseases that can reduce productivity.
4. *Animal handling (skill and knowledge) interaction with health and feed intake*: An animal that is subjected to constant and rough handling may become nervous and will not take sufficient feed. In such cases, it may become more prone to diseases and parasites, hence productivity is low.

In light of this, it is therefore vital to minimize stress in order to make animals more productive and ensure a better supply of animal products, either for home consumption or for sale. Effective livestock keeping needs to include the selection of appropriate species and breeds of animals and the provision of adequate nutrition, health care, housing, hygiene, and other management aspects (DFID 2006). However, small-scale animal production and productivity in the developing world is subject to many constraints. For instance, the capability of households to satisfy the basic requirements for the different groups of livestock is a fundamental concern. Besides, the availability of suitable environmental, socio-cultural, and institutional services is another important

factor. Household capability includes availability of required labor, experience/skill (human assets), finance (financial assets), and access to other basic resources like land and water (natural assets), which varies between the communities and among households.

5.1.1 Animal feed requirements and provision

The needs of individual animals are always changing depending on internal factors, including the physiological state of the animal (species, breed, growth, mating, pregnancy, etc.), and external factors such as climatic stress and exposure to diseases and parasites. Feed management techniques that can be used in feed preparation, handling and delivery can also affect animal performance and, consequently, nutrient extraction. Thus, proper feed management is of paramount importance to provide a balanced diet for livestock in all times. Meeting the changing requirements with the limited resources available is a difficult task and means adjusting the diets of individual animals on a daily basis. This being the case, there is a general guideline that helps for provision of optimal mix from the available resources.

All species of livestock have a greater need for better quality feed especially during their productive and fast-growing ages. The provision of better feed to female animals in the fast-growing stage results in higher pregnancy rates. Improved feeding during pregnancy will also result in better milk production to feed the newborns. All the remaining groups require normal feeding. For small animals (sheep and goats) for instance, a diet based on pasture and browse is normally adequate, except in extreme climatic conditions (drought or excessively cold weather) (Sánchez 2002). Generally, diets need to include sufficient quantities of all of the necessary components (energy, protein, vitamins and minerals) for optimum productivity. Inadequate and low-value feed supply contributes to poor nutrition, which results in low production and reproductive performance, slow growth rate, loss of weight and increased vulnerability to disease and parasites.

Different species of livestock have different nutrient and feed type requirements. There are largely based on the different types of digestive systems, body size, shape of jaw and teeth, bite rates and selectivity feeding stages of production, and the nutritive values of different feeds. Ruminants (cattle, sheep, goats and buffaloes) are

able to take high-fiber feeds such as roughage, grasses and shrubs made up of largely cellulose. This is because they have four compartments in their stomachs, of which the rumen is the largest compartment where bacterial fermentation takes place. Pigs, poultry and horses, which have a single compartment digestive system require more easily digestible feeds to grow and produce efficiently (Hofmann 1989; DFID 2006).

In the Ethiopian highlands, where there is high pressure on grazing lands, it is a challenge to provide sufficient and quality feed with the available resources due to various factors. Farmers in the study areas explained the situation in their own words. In *Kuhar Michael,* they said: "O*ur animals fed us in the past 10 to 20 years, but now we are feeding them; in previous times, livestock was basis of livelihoods and used as a source of food, income and saving, but currently, they are rather costing us in buying and providing their feed and water from other sources due to insufficient availability.''* Farmers in *Lenche Dima*, also explained the severity of open grazing land shortage due to hillside enclosure saying that "*if the situation continues like this, we will not be in a position to practice the so-called mixed crop-livestock system anymore; because we are now forced to constantly minimize the herd size, especially goats due to lack of access to browses and grazing"*. Farmers are shifting their focus to camels with the intention of minimizing supplementary feed cost. Ali (2010) confirms this in his study.

In the production of small ruminants, feeding alone accounts for more than 60 % of the total costs, since nutrition plays a vital role in flock reproduction, quantity of milk production, and lamb and kid growth. Small ruminants, among others, require energy (the most vital nutrient), protein (the most expensive), vitamins, minerals, fiber and water, which is the cheapest but mostly neglected feed ingredient.

As a general rule of thumb, sheep and goats consume 2 - 4 % of their body weight on a dry matter basis; goats require 2 - 9 MJ/day of energy and 15 - 60 gram/day of digestible crude protein for body maintenance. Maintenance requirements increase as the level of the animals' activity increases. For example, a sheep or goat that travels long distances for feed and water will have higher maintenance requirements than animals in a feed abundance situation. Environmental conditions also affect maintenance requirements. In cold and severe weather, sheep and goats require more feed to maintain body heat. Pregnancy, lactation, and growth further increase nutrient requirements (Table 5.1) (Schoenian 2009).

Table 5.1 Nutrient requirements of sheep and goats

Animal groups	**Nutrients Requirement**	
Sheep	Percentage of Protein (CP)	Percentage of Energy (TDN)
Maintenance (154 lb. (69.8kg) matured ewe)	9.6	57.6
Late gestation	11.2	66.7
Lactation nursing twins	14.8	64.5
Early weaned lambs (66 lbs. (29.9kg)), moderate and high growth	14.5	75.8
Lamb finishing 88 lbs. (39.9kg)/4-7 months of age	11.7	77.1
Yearlings (110 lbs.(49.8kg))	9.1	57.6
Goats	Percentage of Protein (CP)	Percentage of Energy (TDN)
Bucks	11	60
Dry doe	10	55
Doe at late gestation	11	60
Lactation: Average milk producing doe	11	60
High milk producing doe	14	65
Weaning kids	14	68
Yearlings	12	65

Source: Sixth Revised Edition, National Research Council, 1985.
Note: a (CP) =Crude Protein; b (TDN) =Total Digestible Nutrient

The feed resource base for rural poultry production is scavenging and consists of household waste, anything edible in the immediate environment and small amounts of grain supplements provided mostly by women. But such a feed does not suffice the requirements of egg layers. The amount of grain supplement and scavenge varies with agricultural activities such as land preparation, sowing and harvesting, seasonal grain availability in the household, rainfall and the life cycles of insects and other invertebrates (Tadele and Ogle 2001: 527). Among the various requirements, protein supply is critical, particularly during dry months, whereas energy supply is a problem during the rainy season. However, any slight change in managing feed, watering and health treatment will improve productivity.

Determining the amount of feed required for poultry is difficult since it depends on environmental conditions, animal status, breed, age, and the type of scavenge. Nutrient requirements can be suggested for the different groups of chicken e.g., see Table 5.2 for nutrient requirement of laying hen.

In order to make poultry keeping economical at rural village level, feed supplements can be obtained from the surrounding environment.

Table 5.2 Nutrient requirements for a laying hen (concentrations in diet on air dry basis)

Nutrients	Requirements (range)
Metabolizable energy (MJ/kg)	11.5-12.5
Crude protein (g/kg)	165-175
Calcium (g/kg)	25-35
Phosphorus (g/kg)	6-10

Source: Smith, A.J. (1990) at http://www.smallstock.info/info/feed/feed-species.htm#poultry

5.1.2 Animal water requirements and provision

Water is the main constituent of the animals' body, constituting 50 to 80% of the live weight, and makes up 80% of the blood. It regulates body temperature and is vital for organ functions such as digestion, waste removal, and absorption of nutrients. Animals mainly take water in the form of feed and drinking water, which is often overlooked while planning and implementing developmental activities, particularly with relation to the expansion of farm operation (Michael et al. undated: 9). More than any other nutrient, deprivation of water immediately leads to reduced feed intake, production, reproduction, poor health, and increased mortality (McCornick et al. 2003: 59; Peden et al. 2009: 18). Thus, constant, adequate and quality supply of drinking water is one of the most essential needs in a livestock feeding program. Among others, strategic provision of drinking water is proposed in the LWP improvement program.

5.1.3 Water resources for livestock

Sources of animal water, according to Zinash et al. in McCornick et al. (2003: 67), include drinking water, water contained in feeds and metabolic water. Water contained in feeds is highly variable from feed to feed depending on the moisture content, which ranges from as low as 5 % in dry feeds to as high as 90 % or more in succulent feeds. For most domestic animals, metabolic water comprises only 5 to 10 % of the water intake, but in the case of sheep it may rise to 15 %. The amount remains unchanged if the metabolic rate is constant. The production of metabolic water becomes more important during the times when animals consume less feed than required, as depot fat and tissue protein are catabolized to supply energy. Drinking water is a very essential need, though it is much less than the water required for animal feed production. Livestock drinking water sources in the study areas include rainwater, surface water

(ponds, rivers, streams and water harvesting structures), and groundwater (shallow and deep wells). All sources have their own limitations.

5.1.4 Water requirements of livestock

As discussed by Zinash et al. in McCornick et al. (2003: 70), the water requirement of livestock is a very individual and specific characteristic, which varies among species, breeds or varieties and individuals. A western exotic breed cow, for example, has a higher water intake than an African zebu cow; the former consumes up to 90 liters/day while the latter 25 liters/day with 350 kg live weight (King 1983). The daily water intake of livestock varies with air temperature, humidity, species and physiological status of the animals, water content of the diet, loss of sweat due to exertion, temperature of the water and the salinity of the supply. Such differences are reflected in the animals' ability to withstand dehydration and their demand for free water, which is variable depending on climatic conditions. The water demands of sheep, goats and camels are not as high as those of cattle.

Water requirement proportionally increases with growth and physiological status like lactation, which varies according to feed intake and quality of the feed. Water consumption increases with increasing dry matter intake and increasing temperature; the higher the dry matter consumed, the more water is required to drink. On the other hand, the effect of ambient temperature on water intake varies among the types of livestock, breeds and state of acclimatization and the direct effect of climate are very complex.

The type of feed plays a decisive role in water intake. Water consumption increases with the level of roughage intake and its nitrogen content and with the intake of other feeds that have laxative properties. In relation to nitrogen content, the inclusion of legumes in tropical diets was found to cause an increased water requirement (Zewdu 1991). Sheep reportedly require more water when on a high-protein diet than on a low, since the nitrogenous end products require a larger urine volume for excretion. Similarly, higher proportions of salt or other minerals in the diet of sheep can result in more urine excretion and, accordingly, more water requirement (Wilson 1970; Bass 1982; Banda and Ayaode 1986; Nuwanyakpa et al. 1986; Abdelatif and Ahmed 1992; Sirohi et al. 1997 in McCornick et al. (2003: 71). Studies with poultry have shown that there would be an increase in water consumption as the contents of fat, protein, salt or

potassium increase in the diet (Zinash et al. in McCornick et al (2003: 71); Andrew (2009: 21-22)).

Any changes in feed intake will have an impact on the level of fecal, urinary and evaporative water losses, and hence water requirement. Since there is a strong relationship between feed and water intakes, any feed improvement/supplementing strategy should take into account the availability of water, dehydration and physiological stress at times of water scarcity. However, the benefits from the economical use of water should be considered using productive parameters as there is trade-off between water saving strategies and production.

In general, the average water consumption of all animals is assumed to be about 25 liters/day/TLU. This being the case, the water demand of the individual animal is variable based on average estimates of water requirements in a specific climatic environment (Table 5.3 and 5.4). The total water requirement is much higher than the voluntary intake in the wet season (at air temperature of 27°C). Schoenian (2009) stated that small ruminants should have adlibitum access to clean and fresh water at all times; a matured animal consumes between 0.75 – 1.5 gallons or 2.8 - 5.7 liters of water/day.

Table 5.3 General guides to voluntary water intake of different classes of animals

Class of livestock	**TLU**	**Daily water requirement**	
		In gallons/day/TLU	**In liters per day/TLU**
Cattle	0.7	10– 27	37.9-102.3
Beef cows		7–12	26.5-45.5
Dairy cows		10–16	37.9-60.7
Horses		8–12	30.3-45.5
Donkey	0.4	5–16	19.0-60.7
Swine		3–5	11.4-19.0
Sheep and goats	0.1	1–4	3.8-15.2
Chickens		8–10/100 birds	30.3-37.9/100 birds
Turkeys		10–15/100 birds	37.9-56.9/100 birds
Camel	1.6	15– 50	56.9-190.0

Source: Pallas (1986) in McCornick et al. (2003: 69 – 70)

Note: TLU = Tropical livestock unit is equivalent to an animal of 250 kg live weight on maintenance. Voluntary water intake is calculated from the water requirements by assuming a water supply from the plants is equivalent to 70 – 75 % moisture content of the plants during the wet season (27 ^{0}C), 20 % during the dry and cold season (15–21^{0}C) and10 % during the dry and hot season (27 ^{0}C. Extremely hot and heat-stressed weather could increase the high values by another 20 to 30 %.

Studies also indicated that water requirement of animals can be calculated on a yearly basis using average required feed per TLU in the form of crop residue or grass and the

amount of water required to grow them. This can be presented in m^3/year or liters/TLU (Table 5.4).

Table 5.4 Water requirement of different classes of animals on a (TLU) basis

Animal groups and their produce	**Conversion factor (CF) for TLU**	**Water requirement**
Cattle	0.79	27.1 liters/TLU/ day
Sheep and goats	0.10	40.0 liters/TLU/ day
Camels	0.66	21.9 liters/TLU/ day
Donkeys	0.66	27.4 liters/TLU/ day
Crop residue production per TLU		136 m^3/year
Grass production per TLU		1557 m^3/year
Dung production for equines		2.4(Kg/day/TLU)
Dung production for ruminants		3.3(Kg/day/TLU)

Source: Tulu et al. (2009) in Challenge Program on Water and Food (CPWF) proceeding (2009: 89)
Note: The water requirement described is calculated depending on season and temperature, drinking water (voluntary daily water intake (liters/TLU) in dry season at temperatures< 27 ^oC

5.1.5 Water stress as a major productivity limiting factor

Limitations in water intake highly affect animals' performance more quickly and drastically than any nutrient deficiency. Water deprivation impacts feed intake, metabolism and productivity. Water intake, depends on the type and size of animal, feed and salt ingested, lactation, ambient temperature and animals' genetic adaptation to their environment (Peden et al. undated). Domestic animals can survive for about 60 days without food, but only 7 days without water. The provision of adequate and clean drinking water is, therefore, a major prerequisite for satisfactory animal milk production, growth and health. But the minimum amount required is affected by various factors and therefore hardly known (Zinash et al. 2002).

There is no consensus on how frequently livestock drink water. But it is suggested that cattle should be watered every day while sheep and goats may be watered every second day in hot climates. Research shows that watering animals every two or three days instead of adlibitum is more effective and economical. According to Zinash et al. in McCornick et al. (2003: 72):

1. blackhead Ogaden sheep, watered once every three days, could save 34 % more water without any adverse effect on performance in the eastern lowlands of Ethiopia (Zewdu 1991);

2. watering highland sheep once every three days is an economical and labor-saving 'drought response' watering frequency (Nuwanykapa et al. 1986);
3. water intake every second day may be profitable for cattle when the distance from the grazing areas is located 10 km away from the water supply (Pallas 1986);
4. Camels have an outstanding capacity to withstand infrequent watering intervals they can withstand the loss of up to 27% of their body weight and are able to drink exceptional quantities of water at a time; and
5. goats will survive better when food is in short supply provided sufficient water is available and sheep suffer comparatively severe hyperthermia relative to goats.

Not only water quantity but also water quality is equally important for animal health and productivity. However, drinking water quality can be affected by a number of factors. Salinity and toxicity, for instance affect its palatability and suitability, which can cause animal health problems and death. Micro-organisms that cause toxicity, e.g., blooms of blue green algae are other factors. Moreover, livestock production practices like over-grazing, direct animal access to waterways and animal waste management are major concerns of livestock water productivity and ecosystem balance.

Though the potential causes of environmental degradation and pollution and their effect on aquatic resources are not documented, factories, agriculture and sewerage are the potential source of major pollutants affecting lakes and rivers in Ethiopia.

5.1.6 Improving water access to livestock

Improvement of water resources has a significant impact on the livelihood of farmers through improving the productivity of animals. Water availability for livestock is relatively critical in the lowlands. This is because animals in most cases, have to walk long distances in search of water, and are usually watered once in two to three days. The effect of water stress can be expressed in terms of energy loss (due to long distance) and low nutrient intake. Water stress is also pronounced in highland areas of the country, especially where rainfall is low both in amount and distribution.

Animals, which are economical in water consumption and effective in meat and milk production, are highly desirable in drought-prone areas. Heat-tolerant animals exhibit the least changes in most of the physiological functions including body water

content at times of hot weather. Thus, selection of animals that have such characteristics is desirable for breeding in hot, desert areas. Pastoralists in Ethiopia select breeding camels considering their ability to withstand drought (shortage of feed and water) and resist diseases (McCornick et al. (2003: 76). Energy loss, which is caused by long distance walking in search of water in addition to low nutrient intake due to dry-season water shortage, is also a challenge in *Lenche Dima*. In the region, camel fattening or conditioning has been started as alternative business activity and also used as a mechanism to mitigate feed shortage and water stress.

According to McCornick et al. (2003: 76), water availability can be improved through a number of ways such as construction of wells, pumps, canals, boreholes, tanks, cisterns, reservoirs, water yards, dams and water-harvesting structures. While selecting any given method, there is a need to consider the production system and socio-economic situation of the farmers. The rehabilitation of water sources is usually a challenge in most cases. For instance, developing water points for farm communities could be a source of conflict if equitable arrangements are not made for sharing the water and facilities, and the respective legal framework is not considered. In such instances, the involvement of institutions such as community-controlled co-operatives and water associations is vital. Besides, efficient modes of operations are required for optimal utilization of water resources.

It should be stressed that the economic use of water has significant implications for ruminant animals, in particular for cattle production, especially in places where water supply is limited in amount and distribution. The scarcity of water during the dry seasons is, therefore, a factor compelling farmers to economize water use in livestock production. In this regard, controlling factors that increases the water requirement of animals is vital in order to save water and serve more animals on a daily basis. Saving water in turn pays back highly during adverse conditions, such as droughts. In short, through treatment and controlling contaminating factors it is possible to improve quality water and derive benefits in terms of herd health and performance. Watering animals using strategically placed troughs instead of direct watering can also help to improve water quality (see section 6.1.3).

5.1.7 Labor requirement for livestock keeping in rural livelihoods

Labor is a basic asset for any livelihood activity. In the case of livestock keeping, it is highly used, especially for feeding and watering activities. In a household, child labor plays the most important role in livestock keeping. The demand and requirement of labor for livestock varies depending on season, animal type and keeping system. For example, a household that possesses goats, sheep and cattle might need two shepherds for grazing. This is because goats have different preferences and modes of feeding, browsing unlike others (grazers). Moreover, the use of stall feeding systems create larger work load at home for women and children and requires additional labor for collecting and bringing feed to home (the stall). Generally, a laborer can keep animals outside the home grazing and watering, while the remaining members at home can engage in other activities like shade sanitation, dung management, and taking care of small stock (sheep, goats, and poultry), sick, and pregnant animals.

Household size and wellbeing coupled with the nature of agricultural activity are the factors of labor availability for livestock keeping (Table 5.5). In the study sites, for instance, it was observed that most poor farmers lack labor for livestock keeping since they cannot afford to buy/hire labor, while better-off households can hire labor which is an aspect of wellbeing.

Table 5.5 Labor requirements for agricultural and livestock activities in the study sites

Variable indicators	**Rice and millet based (*Kuhar Michael)***	**Sorghum based (*Lenche Dima)***
Peak labor months	July, August, October and November	August, October and November
Major labor source	Family, hired and shared	Family, hired, shared and exchanged
Labor price	12-20 Birr/man-day	15-30 Birr/man-day, season dependent
Labor type	Shared, hired (yearly and daily basis), exchanged (human and animal) and collective work	
	Labor arrangements	
Human labor	Shared and hired	Shared, hired and exchanged
Animal labor	*Mekenajo*/joint/	*Mekenajo*/joint/ and exchange

5.1.8 Housing, sanitation and other management requirements of livestock

The provision of housing and secured/fenced enclosures for small animals is often seen as an expensive and luxury facility in small-scale production systems. However, it is possible to construct them from cheap and locally available materials on the farm. Well-

constructed installations, for instance, can protect animals from rain, extreme temperatures, predator attack and spread of infectious diseases. It also keeps nearby crops safe from unwanted grazing damage. Enclosures keep animals separately and prevent the spread of parasites to human beings. They also make livestock handling and management easier and allow planned mating of individual animals, which is the basis of any genetic improvement in the flock or herd. Modest investment in housing and fencing can make keeping of small animals a more profitable enterprise in small-scale farms.

The other determinant factor of productivity improvement is selecting cost-effective and preferred animal species. For example, sheep and goats have higher survival rates under drought conditions as compared to cattle. Moreover, because of their reproductive rates, flock numbers can be restored more rapidly. With regard to goats, water economy is an important biological feature. Even if watered every four days, goats can still provide a reasonable production level. The average carcass weight of Ethiopian sheep and goats is 10 kg, which is the second lowest in sub-Saharan Africa (SSA) (Adane and Girma 2007). Camels, known as disease and drought tolerant, can easily be domesticated and are efficient converts of feed and water to meat and milk. Therefore, especially in arid and semi-arid areas of SSA, engaging in camel production can help to reduce farmers' over reliance on high-risk livestock enterprises (Raymond undated) as they can serve both as food and income source.

5.2 Livestock diseases and preventive measures

Healthy animals yield better and higher value products and can fetch higher market prices. In SSA, animal mortality (higher than 40 %), the highest being of small ruminants, seriously affects all efforts to improve livestock (water) productivity. "*Each animal that dies, 'dies' with all the water it has utilized directly and indirectly during its lifespan, thus, reducing the amount of animal products produced on the one side of the ratio and increasing the amount of water used significantly on the other side of the ratio*" (Tilahun et al. 2009: 173). High livestock mortality rates are caused by several inter-related factors such as feed and water shortage and prevalence of diseases, which negatively affect system stability and increase vulnerability.

In average years, the cattle mortality rate ranges from 5-20 %, while in bad years it can be as high as 20-40 %. Bad years are characterized by severe disease outbreaks usually coinciding with feed shortages (e.g., due to absence of early rains) and most cattle are not productive at all in such periods (Deschimaker 2008: 35-36). The low capacity of veterinary health services to respond to disease outbreaks is also another contributing factor. Therefore, investing in veterinary services and disease control are key areas for increased productivity. Proper herd management, comprising improved decision making on animal type and number, off-take rates, slaughtering age and reproduction rates is equally important. Generally, reducing mortality still remains the most important focus of intervention in most SSA livestock production systems.

In Ethiopia, bovine tuberculosis is the leading cause of mortality and morbidity in cattle, and affects the economy of farming communities and public health in societies where animals and humans live in close contact. But in, *Kuhar Michael (Fogera Woreda),* prevalence is below 10 % (Teshome and Nigatu 2008: 274 - 275). However, trypanosomiasis (*Gendi*), which is transmitted by biting flies (*Tabanid spp*), is one of the major diseases, which attack cattle especially during grazing in the marsh areas. In order to protect against fly bites, farmers mostly keep their cattle inside from 11 a.m. to 3 p.m. Foot and mouth disease (FMD) (*Aftegir*) is the other one, which affects the *Fogera* cattle breed, especially when older than ten years. The study by Hailu et al. (2010) showed that marked drop in lactation, abortion and lameness were recorded in FMD-affected cattle.

As per the study conducted by Belete (2006) and Belete et al. (2010: 14-15), the most economically important livestock diseases in *Kuhar Michael (Fogera Woreda)* other than the aforementioned are black leg (*Abasenga*), anthrax (*Quriba*), lumpy skin disease (*Ekek*), mastitis (*Yetut Beshita*), contagious bovine pleuropnuemonia (CBPP) (*Sal*), dermatophilosis (*Yeqoda Beshita*) fasciola (liver fluke), internal parasites (lung worm and gastro-intestinal parasites) and external parasites (ticks, lice and fleas). Ovine and Caprine/sheep and goats/ are commonly attacked by internal parasites, anthrax, contagious ecthyme, and external parasites. Anthrax, internal parasites, stangles, and African horse sickness are diseases of equine; whereas, coccidiosis, Newcastle disease and external parasites attack poultry (Deschimaker 2008: 35-36).

Animal diseases in *Lenche Dima* include streptothricosis, anthrax, lumpy skin disease, FMD, wart, eye problem, gastro intestinal parasite, black leg (at early stage), and tick for cattle; while mange, anthrax, FMD, and lungworm infestation with goats (Gizaw et al. 1999:50).

5.3 Breed improvement

Livestock breed improvement is one of the most important measures necessary in Ethiopia in order to obtain benefits from the sector. It should be understood that livestock breeds in the country are genetically poor, local types with low productivity performance. Almost all cattle, for example, are zebu types and produce low levels of milk and meat. However, they do relatively well under the traditional production system as compared to the improved ones. Commonly, farmers and policy-makers believe that the introduction of improved breeds of livestock will automatically lead to an increase in animal production. However, it may even lead to a reduction in productivity, unless all aspects of management (feeding, housing, health, husbandry, etc.) are adequately addressed. Cross-bred animals are more susceptible to local diseases and parasites than the traditional ones. They also require higher levels of animal husbandry, health care and supplementary feeding. Therefore, there is a need to be aware of the increased costs associated with cross-breed/pure strain exotic livestock.

Cattle breed improvement in Ethiopia is mainly practiced through artificial insemination (AI) service or bull service, though it is not successful. According to Alemayehu in Kebebe and Alan (2010: http://hdl.handle.net/10568/1981), the major factors that affect the success include performance of the bull, collection, storage, processing and transport of semen, reproductive performance and conception/fertility rates of the cow, estrus manifestation or detection, insemination technique and time, site of semen deposition, presence of appropriate breeding policy, efficiency of AI technicians and commitment of AI centers. The author argues that AI services are extremely poor in the country as reflected in negligible population of hybrids (0.35 %) and exotic (0.04 %) cows in the country and less than 1 % AI coverage. Only 791 technicians had been trained until 2005/06.

The poor AI service in Ethiopia can also be attributed to the constraints associated with the absence of national breeding policy, lack of regular monitoring of

bulls (for reproductive diseases and performance), absence of herd registration and recording system, poor technical, financial and managerial performances (monitoring and networking) of the service. Lack of structural linkages between AI centers and service giving units, absence of collaboration and regular communication between National Artificial Insemination Centre (NAIC) and stakeholders and inadequate resources in terms of inputs and facilities are the other factors crippling AI services in Ethiopia (http://hdl.handle.net/10568/1981). The same is true for the study sites, where lack of awareness and technical limitations are identified as the major problems with respect to farmers and technicians, respectively; thus there is a need for continuous training.

Genetic improvement in sheep and goat production in the Amhara region is still very limited. It has been repeatedly called for by live sheep and goat and meat by the exporters, federal ministry of agriculture researchers, extension agents and producers. The need for improved genetics was agreed upon by all, although consensus was not reached concerning the time frame for implementation. Producers need the system to be practical the soonest possible since the genetic potential of flocks have become degraded due to lack of new genetics and random breeding (AMAREW 2006: 18).

Poultry is relatively at a better level of genetic improvement, especially with respect to egg production. Distribution of improved day-old chicks and 5 (hens):1(cock) package of exotic egg layers (White Leghorns and Rhode Island Red breeds) through agricultural extension service has contributed to the improvement.

5.4 Culturally established responsibilities of livestock keeping

5.4.1 Gender division of labor in livelihood and livestock keeping activities

Gender is one of the important issues in resource sharing/allocation for performing different activities in the mixed crop-livestock production system of the study areas. Labor and time are the two important human assets that need to be considered while defining the role of gender in meeting targeted household objectives. In livestock keeping, gender refers to men, women and children, whose labor contribution is significant. In a household, all members of the family are involved in different livestock-related activities, and have different role and responsibilities. The activities

mainly include collection of water and feed (green grass/weeds, fodder/forages, farm residuals, crop residues and purchased feed), grazing/feeding and watering, shed cleaning and dung management, milk processing, selling and buying live animals/animal products, taking care of the sick, pregnant or other small animals, etc.

The intra-household roles and responsibilities change depending on the household structures. Since households by themselves are variable in their structure, resources (goods, time and responsibilities) allocation, and power distribution in decision making among the members, it is important to consider the intra-household structure and dynamism in order to target for an intervention (Rogers undated). In the case of livestock water productivity improvement intervention, it is also important to see both inter and intra-household characteristics. Time allocation decisions (for each intra-household activity) are affected by the characteristics of the households, the resources available and the constraints they have to face to satisfy household needs, which can be achieved through effective utilization of time.

5.4.2 Inter- and intra-household gender roles and responsibilities in livestock keeping

As indicated above, gender roles and responsibilities are important determining factors of vulnerability and coping capacity of the male and female livestock keepers in a household (FAO 2005:10). This is because gender roles are specific for the different livestock production tasks though some joint activities are still practiced by most households.

According to Rogers (undated), the women's role is vital. Women are responsible for 90 % of food crop processing, providing household water and fuel wood, 80 % of the food storage work and transport from farm to village, for 90 % of hoeing and weeding, and 60 % of the harvesting and marketing activities. Regarding responsibilities in livestock keeping, women are usually responsible for feeding animals, cleaning barns, milking, processing milk and marketing of livestock products. They also play a substantial role in managing confined animals throughout the year, and are involved in feed and water provision and shed sanitation and management. Young children especially girls between the age of 7 and 15 years, are mostly responsible for managing calves, chicken and small ruminants while older boys are responsible for

treating sick animals, constructing shelters, cutting grass and herding of cattle and small ruminants.

In the highlands of Ethiopia, smallholders rear cattle primarily for draft power. Milk production, cash source, manure and fuel are considered as secondary outputs that are mostly controlled and used by women. Cattle and equine are used in smallholder farms for crop cultivation and transportation. Equines are also jointly used by both women and men (Ahmed et al. 2003 in Belete et. al. 2010: 5). Poultry keeping in most developing countries is the responsibility of women, which is also true of the central highlands of Ethiopia, where chickens are owned and managed mainly by women. The men also participate in some processes like selling of live chickens. Here it is important to mention that there are cultural and religious factors in some parts of Ethiopia that restrict contacts of women with extension workers. Consequently, women obtain information through their husbands, which impacts the flow of information (Taddele and Ogle 2001).

In the crop-livestock system of the highlands, women are more involved in cattle production than in arable farming. They clean cow sheds, milk cows, look after calves and sick animals, cut the grass and supervise feeding and grazing of cows, make dung cakes, butter and cheese and sell these products once or twice a week. Women decide on the allocation of milk for different uses. Men feed the oxen and take the animals for veterinary treatment when the need arises. Joint decisions by husband and wife are made regarding the purchase and sale of livestock, though men are responsible for taking the animals to the market. Boys and sometimes girls, generally graze the ruminant livestock. The same applies true in the study sites, where children (boys and girls) who have age of 10 to 12 years are engaged in (Figure 5.2) (Whalen 1984 in van Hoeve and van Koppen 2005: 11; Tangka 2000: 21).

Figure 5.2 Children on grazing field in *Kuhar Michael*) (Picture taken in 2009).

In the study sites, livestock management decisions, roles and responsibilities are different for men and women farmers among and within households (Table 5.6 and 5.7). Men make important decisions like acquiring animals, herd disposal and control over income (from sale of live animals including sheep and goat) and expenditure. Based on the market condition, they fix selling and/or buying; but women exceptionally manage income from sale of butter, egg and chicken. In both the study sites, women manage shed sanitation and manure disposal, feeding and watering, taking care of new-born, sick animals and other activities at homestead. They also control milk processing and decide to allocate milk and its byproducts for consumption and/or sale. During farming season when there is a greater need for labor, women assist their husbands by keeping animals away from growing and harvested crops (Whalen 1984 in van Hoeve and van Koppen 2005: 11; Tangka 2000: 21). Moreover, they take care of children's tasks during school time.

Regional differences are also reflected in some activities. For example, in *Lenche Dima*, milking and barn cleaning are men's duties (since large animals spend their night in separate barns unlike in *Kuhar Michael)*. In *Kuhar Michael*, shed cleaning is left to women and children, since animals pass the night with the farmers in the same house due to risk of theft. Women handle weeding and help with harvesting in *Kuhar Michael* unlike in *Lenche Dima*. The gendered roles, responsibilities and decision-making power in relation to resource access and allocation with in different livelihood activities are discussed below.

Table 5.6 Households livelihood activities and gendered responsibilities in the study sites (computed from seasonal and daily activity calendar and activity-benefit ranking exercises)

Activities	Responsibilities
On farm activities	
Plowing/digging	Commonly boys
Weeding	Both boys and girls, especially older children >12 years
Harvesting	Both boys and girls, but more typically boys
Planting/transplanting	Both boys and girls
Irrigation	Both boys and girls
Terracing	Both boys and girls
Domestic activities	
Collecting fuel wood	Both boys and girls
Fetching water	Both boys and girls
Cleaning house	Only girls
Cooking food	Only girls
Carrying babies	Both boys and girls
Livestock related activities	
Herding	Both boys and girls, but more of boys as age increases
Fodder collection	Both boys and girls
Watering from rivers	Mostly boys and men
Watering at home	Mostly girls
Shed cleaning	Girls
Taking care of pregnant, sick, weak and small animals	Mostly girls and women

Table 5.7 Livestock-related activities and benefit sharing by gender in the two research sites, LD=*Lenche Dima* and KM=*Kuhar Michael*

Variable indicators (activities)	Men		Women		Children		M/W/C	
	LD	KM	LD	KM	LD	KM	LD	KM
Herding (grazing area)	HR	HR			HR	LR		
Feeding (at home)							HR	LR
Watering (at watering points)	LR	LR			HR	HR		
Watering (at home)							LR	LR
Water fetching			LR	LR	LR	LR		
Sick animal care	HR	HR	LR	LR				
Veterinary care	LR	LR						
House/shed cleaning	HR	HR	LR	LR				
Milking and product processing		HR	LR	LR				
Marketing live animal	LR	LR						
Selling animal products		HR	LR	LR				
Use live animals for:-								
- draft power	LR	LR						
- transport	HR	HR	HR	HR				
- labor share/exchange	LR	LR						
Dung collection and use for-fuel			LR	LR				
-manuring	HR	HR						

Note: HR = high responsibility and LR = less responsible but still involved in the activities

Gender roles in livestock keeping in the study sites

Men and women have a clear division of roles in both domestic and productive activities in the sites (Table 5.6 and 5.7). The role of women varies according to the headship characteristics of a household. In men-headed households, the men are engaged in full time work from 7.00 am to 6.00 pm with an hour break for lunch and watering oxen during the farming season, which is from June to November/December, with the exception of weekends and monthly religious holidays (12^{th}, 21^{st}, 27^{th}, and 29^{th} of the month) in *Kuhar Michael.* They usually go to sleep at around 8.00 to 9:00 pm. Women usually take care of the domestic work including livestock management at home.

Children of both sexes greatly contribute to animal herding and other livelihood activities. In *Kuhar Michael* for instance, children (junior school children) are involve in different domestic, educational and farm activities. Every school day (Monday to Friday), they spend an average of three hours a day for livestock related activities like herding, feeding and watering, water fetching (both domestic use and animal drinking at home), house/sheds cleaning, and collecting animal feed (grass and crop residue). Their educational activity lasts about 7 to 8 hours a day. The rest of their time, they are involved in other agricultural and domestic activities such as looking after crops, weeding, growing vegetables and rearing chickens as side work to help the family, plowing and other related activities. During school-off time (July to mid September), they are full time engaged in livestock herding, and assisting their family in both agricultural and domestic activities. They spend more than 10 hours a day for livestock-related activities.

However, household wellbeing conditions and headship dictate such role. In men headed and better-off households in the study area, most men hire farmers who assist them in farming activities. In such cases, the women are totally relieved of farm duties and spend their extra time for social activities. This has limited their productive role. Whereas in women-headed better-off households, since men labor is lacking, most of the women are forced to rent out their land. Thus, their role in farming activities is limited to backyard gardening and other activities. They engage in managing animals from herding to marketing, and do other income-generating job like making cotton thread to sell, engaging in petty trade, making and selling alcohol locally (only in *Kuhar*

Michael), selling firewood and dung cakes, etc. Women of men-headed households are mostly limited to homestead activities. In general, men work around 60 hours per week in the farming season, while women of men headed households work up to 100 hours per week in the whole season (Box 1).

Box 1: Cases studied on gender roles and responsibilities

> In Debre Birhan, North Shoa, the average daily amount of time women spend on livestock-related activities include: 23 minutes for milking, 1.25 hours for cleaning the barn, 1.5 hours for collecting dung, 1 hour for making dung cakes and 1.75 hours every other day for processing milk (Giglietti and Steven 1986 in Tangka (2000)). A study by Yisehak (2008) conducted in Jimma, western Ethiopia, showed that the average daily amount of time women spend on livestock-related activities are: 30 minutes for milking, 1.25 hours for cleaning the barn, 1.08 hours for collecting and transporting dung, 2.15 hours every other day for processing milk, 3 hours a day for childcare, 4 hours for food preparation and 1.30 hours for fetching water. Children spend an average of 9 hours a day for herding, watering animals and collecting dung in Debre Birhan (Giglietti and Steven 1986 in Tangka (2000)), and is 8 hours in the case of Jimma studied by Yisehak (2008 at http://www.lrrd.org/lrrd20/1/yise20011.htm).

Responsibilities

In the communities in the study area, men are fully responsible for generating household income and decide on the use and management of farm land. Related to livestock, women are responsible for fetching water mostly for domestic use, but also for livestock watering. In *Lenche Dima,* however, men are also responsible for fetching water from distant places. Women use donkeys for transporting water in *Lenche Dima*, but in *Kuhar Michael*, women and children's labor is used for such purpose, implying that donkey water productivity for women is relatively better in *Lenche Dima*.

Livestock shade cleaning except shade maintenance and dung management including making dung cakes and storage are women's responsibility. Cattle dung at home is used for home fuel consumption and sale mostly handled by women. But from grazing and farm lands, it is used as organic fertilizer and mostly handled by men and children. Women are also responsible for extraction of butter to add market value, processing butter to ghee, and for milk storage and use. Regarding feeding animals, men and children are responsible for driving animals to communal grazing areas and watering points. They also collect grass, residues and other feed materials. Women

mostly provide animals with feed already collected at the home stead. Regarding marketing of animals and products little has changed compared to old traditions. Looking for veterinary service is men's responsibility. Women combining farming and home activities are more frequent in *Kuhar Michael* than in *Lenche Dima*, women in *Lenche Dima* do not work on farmland.

Gendered access to resources and benefits in a household

Intra-household access to resources and benefits is regionally and timely/seasonally variable depending on various factors. According to Tangka (2000: 28), "*gender division of labor and issues of access to resources and benefits in smallholder livestock production systems in developing countries can be understood better when studies apply appropriate analytical frameworks or household models consistent with the socio-economic context in which the producers operate. Furthermore, information on gender and livestock production is more meaningful if gender division of labor, responsibilities and access to resources and benefits in the whole farming system are fully understood*".

In the study sites, resources like land is mostly accessed by men, but the benefits will be shared among family members. Water resources are accessed differently by family members depending on the location, purpose and season. If it is at homestead, it is mostly accessed by women but also sometimes by children and men. But in the case of grazing land or far away plots to be used for livestock watering, these are mostly accessed by men and children, or for domestic use by women and children. Benefits from livestock are shared among family members whether these are as food source or money source to buy clothes, school necessities and other basic needs. If for home maintenance/construction they are for the whole family. For instance, draft power from cattle is managed by men but the benefit is shared by the whole family.

6 RESEARCH FINDINGS

6.1 Result description and discussion

In this section, the social characteristics and livelihood conditions of the communities under study are described. Following this, the role and interactions of water and livestock in farmers' livelihoods are explained. The interaction/integration of water and livestock in the livelihood strategies of the communities is also discussed. Finally, other supportive and important structures and processes of livelihoods, especially those related to water and livestock resource use and management, are presented.

6.1.1 Social characteristics and livelihood conditions of the communities

In both study sites, farmer communities consist of heterogeneous groups of households based on their different livelihood wellbeing status. In order to identify and select the target groups in focus, households were categorized into well defined groups and subgroups (Table 6.1).

Table 6.1 Social groups and subgroups of farmers in the communities of the study sites (computed from wellbeing ranking exercise)

Criteria /variables/	Groups and subgroups /indicators/
Wellbeing status	Better-off, medium, poor, and poor of poor
Gendered headship	Men-headed and women-headed households
Women farmers	Women of male-headed and women of female-headed households
Age group	Newly married young, medium-aged and old-aged farmers
Poor farmers with respect to land use	Share croppers (share-in/out), renters (rent-in/out) and users of own land
Share croppers with respect to farm residue (feed) access	Farmers who share every farm output and have crop residue access; and those who share only grain output but have no crop residue access
Poor farmers with respect to labor access	Households with family or support labor and those without labor
Poor farmers with respect to livestock acquisition	Households with draft animals and other livestock and those without livestock for rearing or draft power
Poor farmers with respect to access to alternative feed sources	Farmers with private grazing land (*Kuhar Michael*) and grassland from enclosure (*Lenche Dima*) and those farmers without both

The four variables in Table 6.1, wellbeing status, gender headship, women farmers, and age were used to identify the major groups of households, while the remaining variables were used to differentiate subgroups in the poor household categories. Each variable has a specific impact on farmers' capability, especially the poor, to participate in productive activities. In the poor category, for instance, subgroups were identified based on the differences in their responses to each variable. Age differentiation was used for the subcategories with respect to land ownership and labor access regardless of gender. The findings from profiling the livelihood capitals and other features show that each category has its own characteristics (Tables 6.2 to 6.4). The characterization helped to refine and select the desired target groups for different target interventions[14] of the LWP and livelihood improvement programs (see Table 6.21).

Wellbeing generally refers to the condition or state of being contented, healthy, or prosperous. However, farmers in the study sites have their own way of classifying wellbeing status or poverty. According to their criteria, wellbeing status is grouped into four major categories, better-off, medium, poor (capable) and poor of poor (Table 6.2 and 6.3). Accordingly, from a livelihood context, better-off households are those who have a relatively better labor force and more land. They are irrigation users, innovative and participants in extension packages. Most of them are members of *Kebele* councils. The medium-level farmers include households with medium land size and enough family labor, and most are irrigation users. The participation of these groups in extension packages is relatively lower as compared to the better-off farmers. Some of them are members of *Kebele* councils. Elders, newly married young farmers, and some households with incomplete families[15] fall under poor categories, but they are capable of doing agricultural work. Finally, those who are marginalized, landless, aged or sick and dependent on relatives or government aid for labor and food are all grouped under the poor of poor (incapable) category; most of them are incomplete families. Taylor et al. (2007: 6) mentioned this group as chronically poor.

Better-off households have better capability to secure their livelihoods (Table 6.2). This is because they have a better access to almost all livelihood assets, and better

[14] Interventions include the four proposed major strategies of water productivity/livestock water productivity improvement program as indicated in Figure 2.5 in section 2.2.4

[15] Incomplete families in this paper refer to households without husband or wife

capability to diversify income sources through various livelihood activities. This enables them to achieve better livelihood outcomes, secure year round food and to keep extra assets for unexpected shocks, and hence less vulnerable to stresses. With regard to livestock productivity improvement programs, these groups can relatively better perform and be effective than others. For instance, as they are irrigation users, shortage of animal feed will not be a constraint. Moreover, they are able to take their animals to veterinary services for medication during livestock disease shocks. Better-off households have also relatively larger herd sizes with different types of animals. They exploit more from communal grazing land and maximize their benefits. In addition, they manage to earn better returns from the sale of live animals and products, since they usually sell during the peak season when demand and the corresponding prices are high.

Under normal conditions, the medium level farmers can better secure their livelihood as compared to the poor and the very poor farmer groups. However, due to absence of extra outputs, they cannot withstand severe shocks. These farmers also play an important role in livestock keeping and efforts for productivity improvement. For instance, they own livestock of manageable herd size with diversified animal types. With optimal capability, they are able to provide the required feed for most of the year. Access to most of the crucial asset bases enables them to perform their livelihood activities well. This group can be considered as self sufficient unless exposed to extreme shocks. Accordingly, they may not be major targets for direct involvement in LWP programs, whose main goal is poverty reduction and helping the poor.

In contrast, households categorized as the poor of poor group have limitations in accessing basic livelihoods assets like land, labor and livestock. This group is characterized by limited resources in animal and human labor and insufficient or no access to land. The farmers either rent out the land or share it with others due to resource constraints. In case of sharing, farmers are entitled to get only half of the agricultural products. Generally, they cannot even secure their food requirements for half of the year. Households in this category are not engaged in rearing animals as they cannot take care of them or feed them. This group is highly vulnerable to stresses and shocks and has low capability to cope with such conditions. As a coping mechanism, some young farmers migrate for labor work, while others sell firewood. According to the Ministry of Youth, Sport and Culture (MoYSC), young farmers include age between

15 to 29 in Ethiopia unlike the UN international labor organization (ILO) definition (15-24 years old) (Birhanu et al. 2005/07: 4).

Some women also produce and sell locally made alcohol. In extreme cases, some opt for begging or become dependent on relatives. Thus, the contribution of this group to livestock productivity improvement programs has up to now been very limited. However, the young landless farmers of this category have at least an energetic labor force to handle different agricultural and non-agricultural livelihood activities.

The poor (capable) group of farmers represents those who have the readiness as well as capacity to be engaged in development activities if they get the opportunity to access basic assets and services (Table 6.4).

Table 6.2 General poverty (wellbeing status) profiling of rural households in *Kuhar Michael* and *Lenche Dima* by livelihood capitals (computed from wellbeing ranking exercise and respondent profiling)

Livelihood capital	**Wellbeing categories**			
	Better-off	**Medium**	**Poor /capable/**	**Poor of poor**
Natural	- Bigger-sized land (more than 2 ha) obtained from government - Rent in land with share cropping - Water structure-farmers use public sources and some have private	- Medium-sized land (1-2 ha) obtained from government - Some rent-in land by share cropping - Water structure-most use public sources and a few have private	- Small-sized land (less than 1 ha) obtained from government, and/or parents especially young farmers - Some rent out their land with share cropping - Some landless rent in by share cropping	- Very small-sized land from government or none - Rent out for others by share cropping
Human	- Enough family labor and hired labor as a farmer (for farming activities) or animal herder - Hire seasonal labor from market when needed	- Enough family labor - Work jointly or use exchange labor, *debo/jigi* when needed - Or hire seasonal labor from market for some activities	- May or may not have family labor - Mostly use joint, shared or exchange labor - Cannot hire or buy labor - Some get labor help from relatives	- Old aged or sick - Use shared labor or - Depend on community or relatives' labor
Physical	- Pair of oxen and other animals - Bigger house with iron-sheet roof)	- Only pair of oxen - Medium-sized grass or iron-sheet roofed houses	- Single ox or none - Have few other animals or none - Small house with grass roof	- No draft oxen - No other animals - Poor housing
Financial	- Saving (mostly crop stock, cash deposit in state bank) - Other income means such as remittance, sale of livestock	- Some keep other animals as source of cash income - Credit from state bank or ACSI, or micro enterprises	- Credit from ACSI, PSNP, micro enterprises, government bank, office-WoARD, individual lenders or relatives, and cash for work program (in *Lenche Dima)*	- No savings, remittances or other sources - Dependent on relatives or government aid - No credit access

Table 6.2 continued

Livelihood capital	Wellbeing categories			
	Better-off	**Medium**	**Poor /capable/**	**Poor of poor**
Social (member ship)	- Farmers cooperatives, - Irrigation cooperatives, - *Kebele* administration council - Water user association - Water committee	- Farmers cooperatives, - A few are *Kebele* council members - Water user association - Water committee	- A few are members of *Kebele* council - Women cooperatives - Women informal group - Hill development group	- No membership
Livelihood activities (farm and non-farm activities)	- Farming using their own land - Non-agricultural activities including trade, running mill house and additional farming using crop share/lease contracts	- Farming using own land - Some engaged in additional farming using crop share contract	- Engaged in farming as laborer - Non-agricultural activities like selling firewood and locally made alcohol (*Kuhar Michael*) - Some run petty trade - Motivated to work with all limitations like financial, labor, land and draft power	- Few work as laborer - Sell firewood and locally made alcohol - A few are prostitutes - No motivation or incapable of working in farming and other productive activities
Livelihood outcomes	- Year round food security - Extra assets like savings, house in town, cart, water pump motor, mill house, shops, bicycle, and cell phone	- Food security for about 9 months - Perform other works or sell some assets to fill food gap - No additional assets	- No year-round food security (less than 6 months) - Migrate for labor work - Non-agricultural activities like selling firewood	- Not enough food (less than 3 months) - Migration - Begging - Dependent on relatives

As explained before, the basic livelihood assets required for livestock keeping include land, water, labor, livestock and finance. Land, which could be pasture or farmland, is used as source of feed. Labor is an integral input in providing animals with grazing, crop residues, other feeds and water, taking care of their health, constructing sheds and managing animal product processing and marketing activities. Households need to own livestock as a productive and physical asset. In addition, finance is required for the acquisition of livestock and to buy other inputs like veterinary services and feed supplements for the livestock. Access to sufficient water is the other basic input for livestock keeping.

However, access to these basic assets varies among different categories and households. Based on these variables, the three major household wellbeing categories (better-off, medium, and poor) and the sub-categories of poor households were characterized and analyzed. Using characterization, the gaps (constraints) and opportunities were identified for each category to better target households for livestock productivity and livelihoods improvement program (Table 6.3 and 6.4).

Table 6.3 Basic assets and activities in farming communities of *Lenche Dima* and *Kuhar Michael (*computed from wellbeing ranking exercise and respondent profiling)

Characteristics	**Household wellbeing groups**		
	Better-off	**Medium**	**Poor**
Land	The relatively large land size serves as a source of more crop residues and farm byproducts	Medium land size and moderate amount of crop and farm residues	Smaller land size and lesser amount or no crop residue
Crop production	Multiple type of crops, cultivated two or three times a year	Two or three types of crops; cultivated at least two times a year	One or two types of crops; mostly single cropping
Livestock	Cattle, sheep, goats, bees, donkeys and a few camels in *Lenche Dima*	Cattle, sheep, goats, chickens and some bees	Chicken, sheep or goats, some cattle
Fodder	Communal, farm residue and private grazing land	Communal, farm residue and purchased feed	Communal, crop residue and enclosure (*Lenche Dima*)
Farm activities	Crop production, rain fed and irrigation (vegetables), livestock production of diverse types, fodder production, gardening and tree growing	Crop production, rain fed and some irrigation (vegetables), livestock production of limited species, gardening and tree growing to some extent	Crop production, limited livestock keeping of small animals and cattle, limited gardening and tree growing
Human labor	Sufficient family labor, hired labor and seasonal labor	Enough family labor and seasonal labor	Insufficient family labor and joint/shared labor
Animal labor	More than a pair of draft animals as well as donkey and camel power	One pair of draft animals and donkey power (to some extent)	Incomplete/no draft power and no donkey power
Off farm activities	Little trade	Some trade	Handicraft, labor work and petty trade

Table 6.3 continued

Characteristics	Household wellbeing groups		
	Better-off	**Medium**	**Poor**
Livestock water supply	Public source and private	Mostly public sources and a few private	Mostly public sources and a few private
Food security	Year-round food and some extra stock	Less than 9 months	Less than 6 months
Feed security	Year-round with supplemental feed	Moderately tolerable feed shortage	Little or no feed storage, especially for share croppers
Preference of animal	Improved cows	Improved cows and sheep or goats	Improved cows, sheep or goats and bees
Finance	Savings and animal and crop stocks	Some government loans and little stocks	Loan from government or private, remittances
Household size and composition	Bigger but manageable from 2 to 9 (5.6 on average)	Bigger but manageable from 2 to 7 (5 on average size)	Either small or unmanageably large from 1 to 10 (4.1 on average)
Housing	Bigger with separate place for livestock, mostly iron-sheet roofed	Medium, iron-sheet roofed, some have separate space for livestock	Confined, small grass-roofed and no separate place for livestock
Participation	Participate in many extension programs	Participate in crop production, and limited participation in livestock keeping	No participation in livestock at all and rarely participate in crop production

Table 6.4 Profiles and livelihood characteristics of poor men and women farmers according to sustainable livelihood frame (SLF) (computed from wellbeing ranking exercise and respondent profiling)

Criteria /SLF assets/	Livelihood characteristics	Remarks
Natural assets:		* Crop residue share is a common practice in *Kuhar Michael*, but not in *Lenche Dima* ** water charge is only in *Lenche Dima*
Land	- Have less than one ha of fragmented farmland - Some farmers rent out their entire farmland with or without crop residue share* - Some farmers rent out a portion of land that is located far from homestead and use the rest for different purposes (tree growing, fodder production, gardening, mostly maize or other crop production) - Some other farmers, especially the young, rent in land since most of them own only 0.25 ha	
Water	- Poor farmers mostly use the free public sources, even if they are located at distant places - Do not fully satisfy their need of clean water as they cannot afford the price of public drinking water** - Few farmers have private water sources like water harvesting dome and home connected pipe in *Lenche Dima*, and hand dug wells in *Kuhar Michael*	
Human assets:		***Based on farmers' perception and not an actual nutrient content
Labor	- Men-headed households have at least male labor for farming activities - Women-headed households lack male labor - Children labor might be is not available in both men- and women-headed households - Young farmers lack children labor - Farmers fill labor gap through joint/shared/exchange/ working arrangements or help from relatives for basic farming activities - Cannot hire/buy labor due to financial limitations - Farmers are engaged in both on- and off-farm activities in order to fill their basic livelihood needs especially food gaps.	
Time	- Women usually rent out their entire farmland and do not engage in farm activities. Accordingly, they would have relatively more time for other income generating activities including gardening and livestock keeping.	

Table 6.4 continued

Criteria /SLF assets/	Livelihood characteristics	Remarks
Health and nutrition	- Poor nutrition due to the use of single poor quality*** grain like millet, rough pea, and sorghum to minimize food cost; these items are relatively cheaper than rice and teff. - Food two times a day, in extreme cases only once, giving priority to their children Poor health condition due to poor nutrition and sanitation	
Physical assets: Livestock as productive physical asset	**Draft power** - Incomplete/ no draft oxen - Joint/exchange arrangement used if they have managed to have an ox - In the absence of ox, they rent out the land or ask for support from relatives **Other animals** - Some have none at all while some others have a few cattle or small ruminants - Most of them (more than 70 % of respondents) have chickens; a few have donkeys and traditional beehives	
House conditions	- No separate place for animals; the animals spend the nights with the family - Live in small and confined house with poor sanitation, hence vulnerable to respiratory and other diseases	
Access to health and extension	- Do not frequently use health and extension services due to financial and awareness limitation, respectively	
Financial assets: Income source	- Both agricultural and non-agricultural activities are used as income source. Non-agricultural activities include casual labor work (male young farmers), petty trade (especially women farmers), and sale of firewood, dung cakes, locally made alcohol and cotton thread (women farmers). - In extreme cases, children are hired out as laborer Food for work program (*Lenche Dima*)	*ACSI = Amhara Credit and Saving Institution

Table 6.4 continued

Criteria /SLF assets/	Livelihood characteristics	Remarks
Credit and saving	- No saving - Credit service is not accessible for the poor, especially in *Kuhar Michael*. Even if ACSI* provides credit services, the poor farmers cannot participate due to collateral requirements (usually land or livestock). - In *Lenche Dima*, farmers have access to the productive safety net program (PSNP) of the government and NGOs. - Credit system of the government is not suitable due to tight repayment schedule.	
Remittances or other assistance	- Women farmers in *Lenche Dima* enjoy remittances from many young (female and male) migrants in Saudi Arabia and Djibouti, while in *Kuhar Michael* this is very limited	
Social assets: Memberships, Participation, Social groups	- A few women are members of *kebele* councils, while some volunteer women work in health extension and family planning programs - A few women are members of the women cooperative under the farmers' cooperative in *Kuhar Michael* - There is an informal group established by women's league for productive activities with 30 to 40 women, which can be used as an opportunity to approach for targeting. - A hill development group in *Lenche Dima* is also one of the formal social institutions with both men and women. - Kere (*Lenche Dima*); edir, funeral group (*Kuhar Michael*); mahiber, spiritual group (*Kuhar Michael*) are also social groupings in which farmers help each other and strengthen social relations. They also play vital roles in community development work. - Debo/Jigi, wonfel, mekenajo, kinship, etc., are other informal social groups that assist farmers in solving labor shortage problems in major agricultural activities such as weeding, threshing and plowing.	

Table 6.4 continued

Criteria /SLF assets/	Livelihood characteristics	Remarks
Livelihood activities	- Both agricultural and non-agricultural activities as discussed earlier. - Motivated to work with all limitations like finance, labor, land and draft power	
Livelihood outcomes	- No year-round food security (less than 6 months) - Migration for labor work, young farmers mostly migrate to nearby towns/cities (usually road and house construction work) - Some youngsters are involved in criminal activities like theft and prostitution due to livelihood problems.	

The findings obtained from the wellbeing ranking exercises reveal that the two study sites vary in their degree of poverty level or wellbeing status. Poverty appears to be relatively serious in *Lenche Dima,* more than 50 % of the farmers in the site are poor. In *Kuhar Michael*, about 30 % of the households were found to be poor, whereas around 70 % are in the medium and better-off wellbeing classes (Table 6.5 and Figure 6.1).

Table 6.5 Household wellbeing status of the farming communities in the study sites computed from wellbeing ranking exercise

Variable	**Wellbeing categories**							
	Better-off		**Medium**		**Poor (capable)**		**Poor of poor**	
	Kuhar Michael	*Lenche Dima*	*Kuhar Michael*	*Lenche Dima*	*Kuhar Michael*	*Lenche Dima*	*Kuhar Michael*	*Lenche Dima*
Percent of HHs in each category by site	25.8	17.3	43.5	26.7	30.6	38.2	0.2	17.5
Percent of women								
-in each category	6.7	4.0	8.2	9.5	34.4	17.5	100	57.1
-in the total HHs	1.7	0.7	3.6	2.5	10.5	9.8	0.2	10.1
Average percent of HH dependants	0.7	1.4	1.3	2.0	1.2	1.8	Just them-selves	Just them-selves

Note: HH=Households

The difference in poverty level between the two sites can be explained by the variation in biophysical and agro-ecological conditions. In *Lenche Dima,* there is little livelihood diversification due to limited access to land and quality water. Therefore, people are not only vulnerable to stress and shocks but also have limited capability to cope with these challenges, i.e., both the outer and inner side of the vulnerability setting (Chambers 1989) is unfavorable to the people at this research site. In this context, women-headed and young farmer households are the most disadvantaged in relation to access to resources such as land, finance and labor. This stressed livelihood situation is taken as given from outside by the people themselves. It was found out that most of the people in the community tend

to associate the causes of shocks like droughts, floods and climate change with spiritual beliefs, which again means they perceive their life situation as not in their hands.

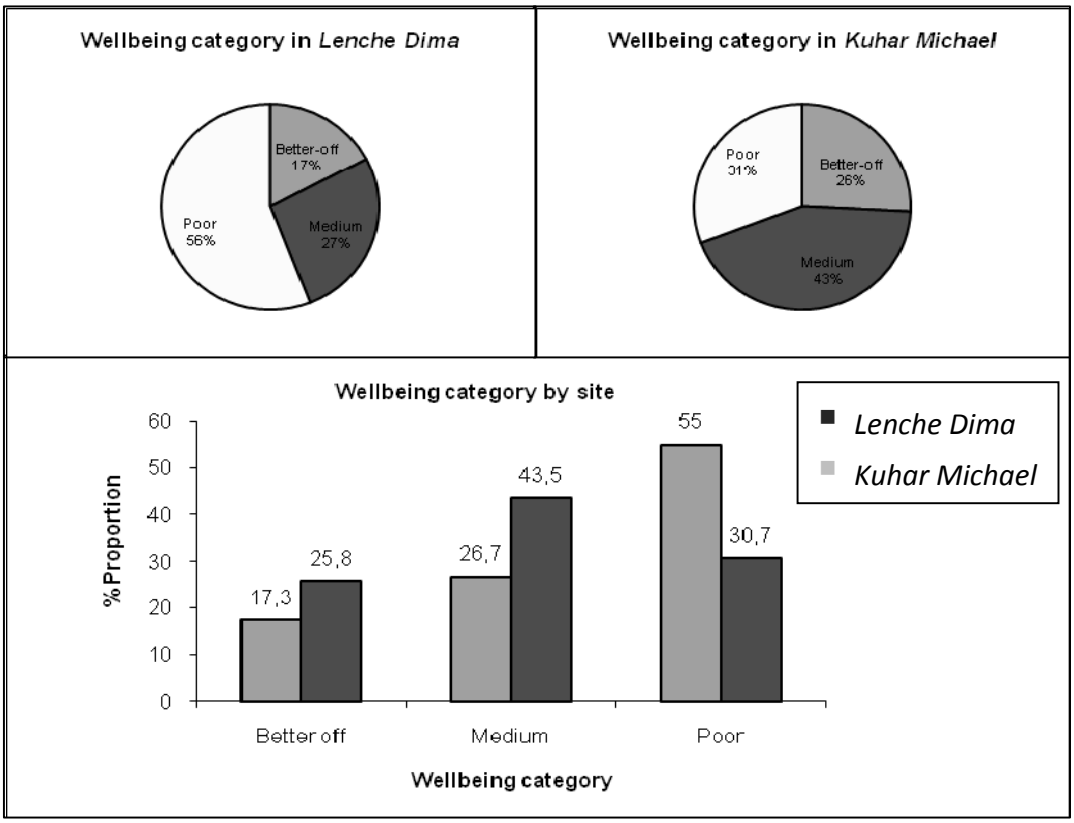


Figure 6.1 Proportion of farmers' wellbeing category in the study sites (computed from wellbeing ranking exercises).

In both study sites, poverty at household level is experienced either in the form of food scarcity (food gap), resource limitation (limited access to vital resources), or both (Table 6.2). The main causes of poverty are mostly related to two basic issues, i.e., access to assets and ownership, and household-gendered headship. Access to assets and ownership is a determinant factor in the choice of livelihood options in relation to poverty reduction. The important assets for the poor include natural assets such as land (in terms of size and quality, which is mostly related to irrigation), water (in terms of both quantity and quality),

human capital (labor capacity and experience), financial assets (in terms of cash or savings) and physical assets (livestock, mainly draft power).

The other issue related to poverty is household-gendered headship, i.e., men- and women-headed households. The finding from the wellbeing ranking depict that women-headed households constitute about 23 % and 16 % of the total in *Lenche Dima* and *Kuhar Michael,* respectively. Out of the women-headed households, more than 66 % is in the poor category. Relatively speaking, there are more women-headed households in *Lenche Dima*, and the trend is increasing. This is mainly due to migration of men (especially young men) coupled with additional factors like divorce and death. In general, about 35 % of the poor were found to be women-headed in both communities (Table 6.5).

Draft power ownership is increasing for men-headed households and decreasing for women-headed (Figure 6.2). Men own more land than women. This implies that most women are deprived of resource access.

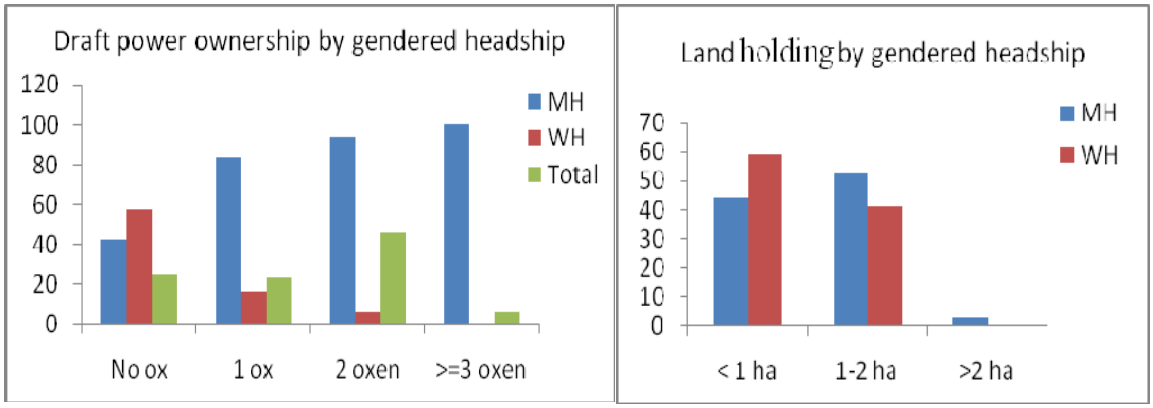


Figure 6.2 Chart showing asset ownership by gendered headship: draft power (left) and land holding (right) (computed from respondents' profile and livestock and land inventory data from the development agents).
Key: MH=men-headed; WH= women-headed

The major determinants of wealth are the amount of land owned and the ownership of draft oxen. Though wealth is a function of the size of household and owned land, more important factor in productivity, however, is the number of draft oxen owned. Draft oxen ownership is a measure of household's capacity for land utilization. The very

poor groups have no oxen, and the poor households have between 0 and 2 oxen, which suggest that their capacity to cultivate the entire landholding is limited. The middle and better-off farmers with 2 to 4 oxen have enough draft power to cultivate more land than their own landholdings. In this connection, local land renting arrangements have enabled middle and better-off groups to access more land. The poor and very poor also benefit from their initial landholding in such arrangements, rent income (50 % of the harvest).

It was learned that the poor and very poor households rent out land ranging from 0.25 to 0.75 ha (1 to 3 *timads*[16]) and 0.125 to 0.375 ha (0.5 and 1.5 *timads*) respectively, while the middle and better-off rent in 0.25 to 0.75 ha (1 to 3 *timads*) of land, respectively. The access to additional land has created the opportunity for the middle and better-off households to expand the production of teff and rice and thus to boost their earnings as opposed to the poor who prioritize food crop production to avoid the risks of cash crop production.

In a nut shell, it was found that lack of capital is the biggest barrier to productivity in the case of poor households, whose livestock ownership, particularly oxen for plowing, is an important source of wealth. Apart from land and draft power, the availability of household labor is another concern for poor households. It should be underscored that the use of labor is manifold; the sale of agriculture labor (locally and outside locality), among others, is the key livelihood strategy for earning income of this group. Regarding livestock keeping, the poor have many limitations, which are discussed below.

6.1.2 Livestock and rural livelihoods: gendered sustainable livelihoods approach for targeting livestock productivity improvement programs

In the mixed crop-livestock system of the study sites, the contribution of livestock to rural livelihoods is limited due to low productivity, though the potential and resources are in place. Livestock production systems are also a concern for water productivity for two reasons. On the one hand, mismanagement has aggravated water scarcity through depletion and pollution. On the other hand, the integration of livestock with water development and

[16] Timad is a local unit used to measure land size. 1 timad is equivalent to 0.25 ha or 4 timads is equivalent to 1 ha

management interventions was found to be minimal, as evidenced from the past experience. This part of the study identifies technical and strategic livestock-related interventions that would help the poor to reduce poverty based on the observed gaps in the system. It also examines the integration of livestock and water management and how such integration enables the poor to fill their livelihood gaps.

In this section, comparative features of the livestock production system in the study sites and their components are described. This was made by taking into account the dynamics of the livestock production system along with the drivers and implications of these dynamics for gender and livelihoods. Impact assessment of prior livestock/water development and management interventions was also put in relation to their contribution to the tackling of environmental degradation, productivity problems, livelihood improvement problems of poor and marginalized groups, and their general role in gender-sensitive poverty reduction. Problems related to livestock keeping, gender and livelihoods are also identified and used in assessing and identifying solution options (interventions) and targets for the livestock water productivity improvement programs.

Basic features of livestock sub-system: comparative analysis of dry/wet areas

The findings indicate that the production systems in the study sites constitute livestock as an important asset base in addition to serving as a source for power, income, food, and manure. In *Lenche Dima*, located in the dry and low-potential cereal zone (Gizaw et al. 1999: 42), livestock serve as a safety net in the face of recurrent food crises. During such events, farmers sell animals and buy grain to fill their food gap. Livestock, in particular oxen, are considered as an indicator of social status and household wellbeing in most rural areas of the country in general and the study sites in particular. Farmers largely depend on crop residues and browses as major feed sources for their livestock (Table 6.6). Herd size, particularly the number of goats, is decreasing in *Lenche Dima* due to feed constraints as a result of shortage of grazing and browsing areas as also stated by Ali (2009: 85). The expansion of cultivated land through distribution of the communal grazing land to landless young farmers, and the enclosure of degraded hillside areas are the two driving forces of the problem.

Livestock have the same contribution to farmers' livelihoods in *Kuhar Michael*. However, the feed source is somehow different and grazing lands and crop residues, especially rice husks (in the plain land), are used as major feed sources (section 6.1.2.2).

Regarding the composition of livestock, only indigenous breeds with very few examples of improved varieties are owned by the farmers. There are few (not more than 6 owned by 3 farmers) improved cattle breeds in *Kuhar Michael* obtained through the AI service. Farmers mostly keep cattle, goats, sheep, donkeys, camels (only in *Lenche Dima*), chickens and bees. In general, in both study sites keeping cattle, poultry, goats and donkeys are the major livestock activities, followed by sheep rearing and bee keeping. Though limited, camels are used for transportation and as a symbol of social prestige in *Lenche Dima*. Recently, camel fattening and conditioning has become a preferred enterprise for young and medium-level farmers due to the high returns. These camels are obtained from the neighboring Afar pastoralists. However, due to socio-economical issues, only male camels are made available to market by these pastoralists. In *Kuhar Michael*, cattle are dominated by the *Fogera* breed, locally known for high milk production and esteemed for traction power and meat production (Descheemaeker 2008: 38; Birhanu et al. 2010: 15). But currently, *Fogera* cattle are inter-breeding with the highland zebus, which results in dilution of their good quality genetic lines. This is due to the trekking of large numbers of animals from the upland and adjacent woreda (*Dera*) during the dry season in search of feed and water, and sometimes animals also trekked from the plain land to the uplands during the rainy season due to over-flooding of grazing lands.

In both study sites, cattle, mainly oxen, are kept for draft power purposes whereas cows are used for replacement. Cows are also used as a source of milk for home consumption. Since selling raw milk (except to the cooperative milk shop at *Woreta* tawn for *Kuhar Michael*) is not a common practice in the area, the milk is further processed to butter and similar byproducts. The byproducts in turn are used for cash income, food, and cultural hair treatment; women are the main beneficiaries. There are also some instances where cattle are sold during critical periods of food shortage when the income from sale of small animals is insufficient to cover expenses and when there is no other animal available. Cash from the sale of goats and sheep is primarily used for expenditures like clothing, tax

payments, school expenses and others. These animals also serve as a source of food security. Besides, they are slaughtered during cultural and religious festivities. Donkeys and camels are used for transportation power. Donkeys play a significant role in transporting grain and crop residue in *Kuhar Michael* and in collecting water in *Lenche Dima.* Camels are used for the transportation of grain and crop residue in *Lenche Dima;* farmers in *Kuhar Michael* do not use animal power to collect water. Occasionally used for own consumption, chickens and eggs are sold by women to cover daily household expenses. Honey and bee colonies are mostly produced for sale.

The findings with respect to livestock productivity show that livestock keeping in the study areas is limited to subsistence due to different limiting factors. With some regional[17] differences, productivity of cattle is generally poor due to diseases, shortage of feed and water and poor veterinary services. As farmers in the study sites witnessed, the low productivity performance of the animals is expressed by the low milk production and low rates of calving, which are caused by feed shortage and quality problems. Currently, the calving rate of cattle is reduced to once in every 2 to 3 years. The cows do not get into heat and do not conceive as usual due to lack of energy for reproductive body functions. Moreover, milk production is lowered to less than a liter/day.

In *Lenche Dima*, reduction in productivity is the cumulative effect of different factors. Animals have access to water only every three days, and the intervals increase during the dry season. Moreover, the moisture content of the feed in the dry season is low, since the animals depend on dried crop residues, especially sorghum stover. The animals migrate long distance to get to water sources (at least 6 hours round trip), which wastes their energy and time for grazing (Figure 6.3).

[17] Regional difference in this thesis means differences in the study sites

Figure 6.3 Animals feed and water availability during dry season in *Lenche Dima*) (Picture taken in 2008)

Animal breeding is another aspect of livestock management that helps to improve productivity. The natural breeding system of the animals in the study sites is seasonal. As observed by the farmers, effective mating is mostly related to the availability of sufficient feed, especially for cattle. In other words, if animals get adequate feed, they will have normal physiological functions and be ready for breeding; female animals will come to heat and be able to conceive, and the males produces active and effective cells. Goats and sheep, however, mate all year round, i.e., at least twice a year giving 1 to 3 kids per kidding (Ali 2009: 68). December and January are the preferable months for breeding since supplementary feed (crop residues) is better available.

In both study sites, artificial insemination (AI) services are used to genetically improve cattle and are provided by the *woreda* agricultural office. However, the service has its own limitations, technical problems, and the farmers are mostly not aware of the service. At the *Woreda* level, there are not enough well trained inseminators. Farmers are also not good at identifying cows in heat and the critical estrus period. The farmers stated that training was given to selected farmers to support the *woreda* AI experts though this was not found to be effective. All in all, the service in the study sites is not bearing fruit. According to the farmers in *Kuhar Michael,* for instance, cows only conceive after 5 to 6 trials.

Livestock culling is usually governed by market demand and seasonal cash needs. Male animals with good body condition are culled for sale as long as they can fetch a good price. There are also some stressful periods (like the drought of 2009) when forced culling takes place. Under such conditions, however, farmers are obliged to sell their animals at a lower price due to excess supply at the local market and the deteriorating body conditions

of the animals. Farmers sometimes cull unwanted animals from the herd as a coping strategy during feed shortages and seasonal disease shocks.

Livestock input-output access, uses and management conditions in the study areas

In livestock production, feed and water are the primary inputs. Labor, market, veterinary and extension services, and other institutional and socio-cultural issues are the other requirements for better productivity.

Feed as a natural asset is basic to livestock keeping. However, in the study sites, the provision of feed is a major livelihood challenge for the farmers. Feed is costly in relation to labor and other farm inputs (Peden et al. 2009: 190). Depending on the type, age and other factors, animals' feed requirements are variable. In addition, due to the agro-ecology and environmental variations, regional differences exist (see Chapter 5). In general, the farmers in the study sites, especially in *Lenche Dima*, use controlled provision of crop and farm residues as a source of feed rather than free grazing on open communal grazing land. This is mainly due to the deterioration and shrinkage of communally used grazing lands. In *Lenche Dima*, for instance, free grazing areas are not available at all in the watershed; the enclosed hills are the only available natural grazing areas and can only be accessed for the cut and carry feeding system. Although there are two communal grazing lands close to watering points (wetlands around the rivers Alwuha and Hara outside the watershed, Figure 6.3), these are at a far distance and dry up from April to June.

The major feed sources in their spatial and seasonal distribution vary between the study sites. Rice husks, millet straw and maize stover are the main feed sources in *Kuhar Michael,* while teff straw followed by sorghum stover and maize straw are used in *Lenche Dima*. Other green farm residues and communal and private grazing land are secondary sources in *Kuhar Michael,* but in *Lenche Dima*, these are grass from enclosures and in some cases purchased feed (Ali 2009: 65, 68 and 75). However, the availability (both in quality and quantity) and seasonality of crop residues and farm products depend on crop type and farmland size, quality, ownership, and mode of use.

Farmers who have access to irrigated land have a better feed security. Accordingly, they have multiple (two to three) crop growing seasons in a year that enable

them to collect enough feed from crop and other farm residues. Those farmers who have private grazing areas in *Kuhar Michael,* and those who have a land share in the enclosures in *Lenche Dima* also get better feed in addition to the communal grazing. Access to irrigated/enclosed land and private grazing area varies with households' wellbeing status. Poor farmers in *Lenche Dima*, for example, have access to the enclosure land, which is distributed equally to poor and landless farmers (0.25 ha/ individual), who do development work there. According to the *Kebele* DA report, among the enclosure land users, about 25 % are poor women farmers. In *Kuhar Michael*, private grazing land belongs mostly to better-off and medium level farmers who have more farmland. Though irrigated land is equally accessible to all types of farmers, the better-off and medium-level farmers benefit more, since most of the poor farmers rent out their irrigated land to these groups of farmers.

The opportunity for obtaining animal feed from enclosures and private grazing lands encourages farmers to adopt feed-conserving strategies like controlled grazing, hay making, and stall-feeding systems. Communal grazing areas are open for both men and women farmers, regardless of social groups. However, the benefit depends on herd size and grazing frequency, which is a function of labor availability, wellbeing status and endowment right.

In both study sites, the availability of feed varies seasonally and regionally. Feed availability and access to communal grazing areas is better in *Kuhar Michael* as compared to *Lenche Dima* (Table 6.6, 6.7 and 6.8). Feeds take two forms: dried and wet. Availability of green feeds depends on the amount and duration of rain, and is accessible from August to December. In *Lenche Dima*, during the dry season (January to July), farmers use dry feeds like teff straw and sorghum stover (also used as fuel) as a main feed source (see Table 6.6). There, about 60 % of the yearly feed is covered by sorghum stover, teff straw, and other residues from pulse crops. Since residue from chick pea is unpalatable to other animal groups, it is used only for donkeys, which reveals the feeding priority where donkeys are the last group of animals to be provided with feed.

From April to June, feed shortages often occur in *Lenche Dima*. In such cases, farmers are forced to purchase supplementary feed or they may cull/sell some of their animals. In consideration of feed shortage, farmers tend to prefer keeping camels, which

have unique feeding and watering behavior and ability to resist shortages. Besides, camels can take any feed grown in dry areas and stay more days without water, unlike other animals. Thus they have a better LWP than other animals (Owen et al. 2005: 411-412; van Hoeve & van Koppen 2006: 22).

Table 6.6 Seasonal calendar of animal feed availability for *Lenche Dima*

Feed type	**Months**											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Crop residues												
Crop aftermath												
Farm by-products: grass, weeds and poorly performing crops (‘*Kezeba*’)												
Grazing on open field and hill side areas												

Source: Author, compiled from seasonal calendar exercise, group interviews and discussion

Note: *Deeper colors show the level of feed availability and animal dependency over the feed type.*

= *high availability and greater dependency of animals on the available feed type;*

= *less availability and low dependency on the feed available; hence there is a need for feed supplementation;*

= *moderate availability and animal dependency corresponding to the color.*

In *Kuhar Michael*, animals graze on communal open grazing lands throughout the year. The feed is abundantly available in June, July, November, December and January (Table 6.7). In addition, farmers traditionally leave a small portion of farmland or the back yard for grazing, especially for oxen, which is not in the case in *Lenche Dima*.

Table 6.7 Seasonal calendar for feed, water and other livestock-related factors for *Kuhar Michael*

Livestock- and water-related factors	**Months**											
	J	F	M	A	M	J	J	A	S	O	N	D
Animal diseases	1	1	1	1	1	1	1	3	**5**	**5**	3	1
Human diseases	2	2	2	2	2	**5**	3	2	**5**	**5**	3	2
Insects and flies	1	1	1	1	1	1	1	5	**5**	**4**	3	1
Grazing	5	3	2	2	2	5	5	**1**	**1**	**1**	5	5
Crop residue	**5**	**5**	**5**	**5**	**4**	3	2	**1**	**1**	**1**	**1**	**5**
Rainwater access	**1**	**1**	**1**	**1**	3	5	5	5	3	**2**	**1**	**1**
Water (rivers & springs)	**2**	**2**	**1**	**1**	**1**	**1**	4	5	4	3	3	3
Food shortage	1	1	1	2	3	**4**	**5**	**5**	**4**	3	1	1
Labor shortage	1	1	1	1	1	3	**5**	**5**	**5**	**5**	3	2

Source: Author, computed from seasonal calendar exercises
Note: 5=high and 1=lower; numbers in red refer to problematic issues and green refers to better availability

Table 6.8 Feeding calendar for *Kuhar Michael*

Feed source	**Months**											
	J	F	M	A	M	J	J	A	S	O	N	D
Crop residues												
Hay												
Weeds and grasses												
Communal grazing (wetlands)												
Communal grazing (uplands)												
Private pasture grazing												
Aftermath grazing												
Green maize stover												
Critical period												

Source: Descheemaeker (2008: 37)

The matrix scoring exercise (Table 6.7) shows that feed from natural pasture and crop residue is hardly available during August to October. This is mainly due to over-flooding of the grazing area, which means a serious feed wastage. Similarly, there is an acute shortage of crop residues and feed from communal grazing in the wetlands (plain land) during these months (Table 6.8). During this time, biting flies and insects have also an impact on grazing land accessibility, as they prevent the animals from grazing.

Consequently, animals get stressed, lose resistance and will be exposed to water-borne diseases. These unfavorable conditions collectively impact efficient utilization of feed and water as well as livestock water productivity. This implies that though water and feed are in excess, animals cannot profit from this situation, thus productivity is not enhanced.

Labor is another limiting factor that affects livestock productivity during August to October, the peak labor seasons for crop production activities. What aggravates the situation is that farmers in these seasons are affected by malaria. As a result, there is shortage of labor for livestock management. The foregoing discussion reveals the integration and interdependence of the various factors in livestock productivity improvement, which need to be considered in targeting intervention for LWP and livelihoods improvement.

Water is another crucial input for livestock productivity, as successful livestock production heavily depends on access to adequate and quality water. In *Lenche Dima*, water shortage in the dry season is a major constraining factor in livestock productivity. Animals during this season get only little water and lose energy while searching for water sources in distant places. Costs are incurred to the farmers when they buy water from the domestic supply system. In *Kuhar Michael*, however, as mentioned by the farmers, physical water scarcity is not a serious problem. There, the repeated failure of hand dug wells and pits during the rainy season and the poor quality of water are the major concerns for livestock productivity (see sections 6.1.3 and 6.1.4).

Other inputs such as veterinary and extension services including credits are not sufficiently available for the poor farmers in the study sites. To begin with, there is no veterinary clinic at the *Kebele* level. Because of this, farmers (mostly men) trek with their sick animals to the nearby towns, Woreta for *Kuhar Michael* and Hara for *Lenche Dima*, for the service. The veterinary service is mostly provided by government clinics. Sometimes, when there are shortages of drugs at the public clinic, farmers are forced to use private drug shops where costs are higher. On the other hand, though experts are assigned at the *kebele* level, the extension service for livestock is limited. The poor farmers in *Kuhar Michael* have access to credits solely availed through ACSI, while in *Lenche Dima* relatively a better credit service is available from the productive safety-net program

(PSNP). The livestock markets are far from the households and have poor facilities and information services.

Livestock output management in the system includes access, control and governance of animal products and byproducts (see the detail in section 5.4.2). Depending on socio-cultural and/or religious factors and individuals' perception and awareness, the use of animal products (especially from camels and goats) varies regionally, socially and economically. For example, in *Kuhar Michael*, camel and goat products are not consumed for religious reasons, as orthodox Christians are forbidden to eat the meat. Nonetheless, it was observed that goat meat is consumed by some groups of the community, especially youngsters and those who are less conservative. As it is relatively cheaper than mutton, it is also consumed by some low-income farmers. In *Lenche Dima*, Muslim community, camels are still used as a means of generating cash and for transport. There is no religious ground that prohibits the use of camel meat and milk, which are relatively expensive. Goats widely reared at the site are for home consumption and spiritual offerings. There is color and sex preference for goats for spiritual services, and black and female goats are mostly not used for sacrifice. It is possible to say that all these practices do not consider LWP and are thus a concern and target for development interventions.

The main energy sources in the study sites are wood and dung cakes. In *Kuhar Michael*, the majority of the farmers (more than 90 %) use animal dung as a primary source of fuel. In *Lenche Dima*, on the other hand, dung is not commonly used as a fuel source, but serves as an income source. There, wood and maize and sorghum stover are the main fuel sources (Descheemaeker 2008: 41).

In short, the results show that inputs, especially water and feed, are the major productivity constraints at both sites, even though the severity varies between the sites and among households. Based on this, the ensued challenging input-output management factors of households are briefly discussed in relation to livestock productivity and thus livelihoods improvement.

Absence of adequate and quality feed is the foremost problem for all groups of farmers irrespective of wellbeing status, age, and gender. Diseases and a limited access to veterinary services are the other problems all farmers face. The ever-increasing human and

livestock population pressure has resulted in farmland shortage, especially for young poor farmers. This not only limits livestock production but also has become a major livelihood challenge.

Moreover, economical and physical water scarcity affects farmers regardless of their regional, wellbeing and gender differences. Women-headed and poor young farmer households also suffer from labor and financial problems coupled with poor credit services (especially in *Kuhar Michael*). On the other hand, limited awareness/experience and extension service in the livestock sub-sector, risk of theft and predators (goats) due to labor shortage for women farmers, and risk of biting pests (sheep) in the plain land flood-prone area of *Kuhar Michael* are that discourage the poor farmers to engage in livestock production.

Due to these livestock production limitations, problem priority, order varies between sites. For instance, grazing land/feed is the foremost problem followed by dry season water scarcity in *Lenche Dima*. In *Kuhar Michael*, livestock diseases, especially trypanosomiasis and internal parasites, comes first and followed by flooding of grazing areas, lack of quality water and feed. Generally, it can be said that water is the main limiting factor in both sites for livestock productivity due to mismanagement/inefficient use and poor availability. It affects feed availability, health and production performance of the animals.

Livestock contribution to the livelihoods of the poor and marginalized households

Livestock is identified as an important asset that can provide job opportunities, improve income, nutrition and health, and hence improve livelihoods and gender equity through interventions focusing on women and poor men. In light of this, the poor farmers, who have gaps in food, income and other basic resources, have an opportunity to address their gaps through appropriately targeted LWP improvement programs. The program focuses not only on ownership/acquisition of livestock, but also on livelihoods in general and environmental benefits from livestock. Livestock ownership implies a socially respected set of property rights including acquiring, using, managing, disposing, etc. (van Hoeve and van Koppen, 2005), which vary among households, especially by gender lines and wellbeing classes.

Researchers argue that livestock are the most important assets of the poor for reducing poverty. The findings of this study, however, show that it is the better-off and medium-level households that own and make use of livestock and not the poor. Men-headed households are the main beneficiaries in both study sites, especially regarding benefits from cattle. Few women-headed households own draft power and chickens in *Lenche Dima*. Ownership also includes donkeys and cattle in *Kuhar Michael*, implying a relatively better gendered ownership of livestock. Of the sample women farmer respondents (n=34), none of them was found to own goats or sheep, since they were from the poor categories (Table 6.9). This indicates that the poor women are not in a position to own even small animals.

Table 6.9 Livestock holding by men- and women-headed households in the study sites

Livestock type	**Sites**				Total (%)
	Lenche Dima		***Kuhar Michael***		
	MH	WH	MH	WH	
Total households	36	15	41	19	111=100
Cattle: Oxen	34	2 = 13.3	35	7 = 36.8	78 =70.3
Cows	18	-	31	9 = 47.4	58 = 52.3
Other groups	18	-	31	10 = 52.6	59 = 53.2
Goats	9	-	4	-	13 = 11.7
Sheep	1	-	2	-	3 = 2.7
Donkeys	18	-	16	2 = 10.5	36 = 32.4
Chickens	22	4 = 26.7	31	8 = 42.1	65 = 58.6
Beehives	1	-	6	2 = 10.5	9 = 8.1
Camels	1	-	-	-	1 = 0.9

Source: Author, compiled from household interview and respondents' profile
Note: MH=Men headed; WH=Women headed

Findings from the ownership analysis, which emphasizes the importance of draft power acquisition (Table 6.10), shows that in both study sites only 50 % of the farmer households owned complete draft power (pair of oxen, according to farmers' standard). 25 % do not possess oxen at all and nearly another 25 % is involved in joint and share cropping arrangements because of incomplete draft power ownership. Farmers working with shared arrangements (share out) derive less benefit from their land, which discourages

them from keeping/owning more livestock. On the other hand, such arrangements provide an opportunity for the counterparts to get access to animal feed.

Traditionally, a pair of oxen is required for plowing. Sometimes a donkey is used as a substitute for the missing oxen, which is socially considered as inferior. Cows, with the exception of infertile ones, are not used for plowing, which is socially perceived as mistreating the animal. Women do not use oxen for plowing, since this job is culturally perceived as "too difficult" for them. Accordingly, women farmers, widows for instance, who have their own plot, are obliged to rely on male relatives or have to hire a labor force to plow, or otherwise rent out the land with share cropping. A study conducted by Descheemaeker (2009) suggests that using a single ox for plowing will minimize energy by 20 %, and thus improve LWP. Contrary to this, farmers believe that "plowing with a single ox is like seeing with one eye", which implies that it is inconceivable for them to use a single ox to plow their land. Further investigation is needed on how to create enabling conditions to bridge this gap.

Table 6.10 Draft power ownership and distribution by site and household headship

Size of draft power (oxen number)	***Sites***							
	Lenche Dima				***Kuhar Michael***			
	Men		Women		Men		Women	
	No	%	No	%	No	%	No	%
Total households	531	79.3	139	20.7	40	66.7	20	33.3
No draft power	70	42.2	96	57.8	3	18.8	13	81.2
Incomplete	129	83.8	25	16.2	7	50	7	50
Standard (a pair)	288	93.8	19	6.2	18	78.3	5	21.7
> Standard	40	100	0	0	7	100	0	0

Source: Author, computed from respondents profiling and livestock inventory data from the DAs

In the study sites, credit systems especially related to repayment schedules (for instance, a credit for buying draft oxen, which should be serviced within 6-12 months) and their target, are factors discouraging poor farmers to become involved in the livestock sector.

Another study entitled "Women Livestock Managers in the Third World" (http://www.ifad.org/gender/thematic/livestock/live_2.htm) shows that *women in Africa in*

general have fewer rights of ownership over livestock and its means of production than their labor contribution would warrant. Women's ownership of livestock is often considered a 'secondary right.' To date, an understanding of women's role in livestock production in developing countries has been limited by cultural biases that underestimate the women's contribution. Scientists and development workers have tended to concentrate on male-oriented activities (beef production, large-scale enterprises, etc.), thus neglecting those activities that women are generally engaged in, notably, milk production, the raising of small stock and poultry, meat and hide processing, etc.

Table 6.11 Perceived total access and control of resources by middle income women as compared to their husbands in North Wollo, Ethiopia

Resources	**Perceived access**		**Perceived control**		**Benefits**
	Husband	Wife	Husband	Wife	
Spring water	25	75	25	75	Dinking and preparation of food
River	50	50	50	50	Washing and irrigation
Land	70	30	70	30	Crops, trees, building, burial
Cow	30	70	70	30	Milk, butter, cheese
Oxen	70	30	100	0	Plowing, meat
Sheep & goats	50	50	60	40	Meat, income
Chickens	0	100	0	100	Meat, eggs, income
Grazing land	100	0	100	0	Animal feed
Horticulture	55	45	55	45	Food and income
Extension	80	20	100	0	To plant in rows, vegetable production
Crop produce	60	40	40	60	Food, income
Trees	50	50	60	40	Fuel wood, shade, construction, income
Credit	100	0	100	0	To buy oxen and seed
Labor	35	65	50	50	To increase yield
Team work	65	35	100	0	To facilitate work
Farm inputs	100	0	100	0	To increase production
Cash	55	45	50	50	Food, health, clothes, education and to buy livestock

Source: Percy, 1997 in van Hoeve and van Koppen (2006: 7)

A study comparing the access and control of resources by gender shows that women are not in a position to make use of oxen as a physical asset, but use donkeys for

transportation of water and grain (Table 6.11). In most areas, women own sheep, goats and chickens and have better access to animal products like milk and egg, though less control over cows. In the Ethiopian highlands, those husbands in possession of oxen are the only ones that have access and control over credit and farm inputs, and are mostly targeted by extension services, whereas their wives have full access and control over chickens and are more involved in water collection, especially from springs.

In men-headed households, livestock is jointly owned, managed and used by all members of the family (men, women, and children) with some exceptions. For instance, animals obtained as gifts at time of marriage still remain under the ownership of the respective spouse, and are jointly managed and used thereafter and otherwise separated. This being the case, a relative variation is observed among household members with respect to roles and responsibilities in management and share of benefits (see section 5.3). Livestock ownership has a direct relationship with the ownership of or access to other assets such as labor, finance, land and social assets (see Figure 6.4). There are also some cases where farmers will be reluctant to own animals for fear of risk of death, theft and other losses. This is partly explained by lack of appropriate veterinary services, the perception of farmers towards the available service delivery system, and lack of social and economical security.

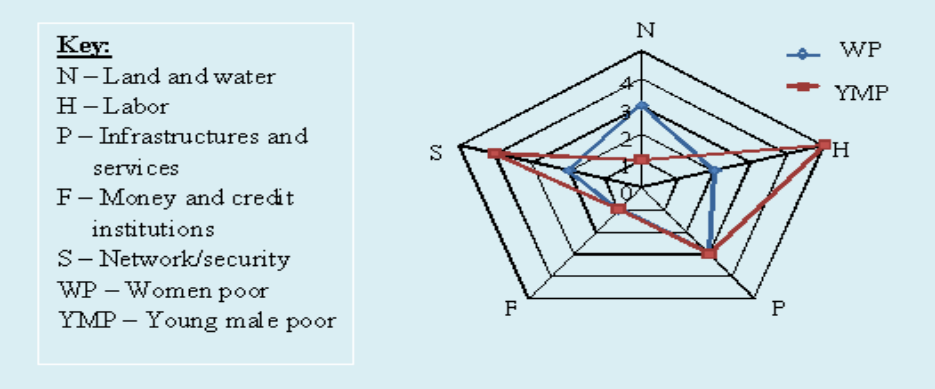


Figure 6.4 Access to and ownership of assets by women and young male poor farmers (resource network diagramming exercise).

The spider diagram (Figure 6.4) shows that both poor farmers groups have limitations in accessing assets required for livestock keeping and investing in productivity

improvement within their livelihood activities. Poor women mainly have financial problems with respect to acquisition of livestock in addition to labor and social asset constraints, whereas the young male farmers primarily have limitations in accessing land and financial resources. Commonly, both groups have access to other assets like physical and human capital and services. Thus, investigating possibilities to improve the access to these shortages of resources and ensuring equitable distribution would help to enhance productivity of the other assets they have already at hand and their contribution to over all livestock productivity. For instance, labor problems of poor women- and men-headed households can be addressed by improving their access to nearby or private water sources (the physical asset of the natural capital, water). See Box 2.

Box 2: Contribution of proximity of water and feed sources for labor-constrained women in *Kuhar Michael*

Ergo Wotet is widowed farmer (for 6 years). She lives in Shiwonze Got of *Kuhar Michael Kebele*, Fogera *Woreda*. She went to school up to the fourth grade. With her 4 of her children, she headed the family and managed to send all children to the village school for a half day time. She owns about 1 ha (4 *timad*) of land, half of which (the rice field) is shared out by a half-share arrangement including crop residues. She allocated the other half to maize, vegetable, crops and grass (grazing). With the assistance of her son (half-day student) and sometimes her brothers, she managed to grow a few fruit trees and vegetables and to keep 2 milking cows, 1 ox, 3 laying chickens and 1 modern beehive. She uses water from the nearby communally excavated pond for such activities. She has tried to dig her own well, but failed due to the collapsing problem.

However, she has a food gap. The rice grain that she obtained from the shared land covers only nine months. To fill this gap, she sells rice at a good price and buys millet at lower price, and buys additional food grain using cash income from selling butter (Birr 50 per week from the two milking cows), eggs (Birr 30 per month) and from savings of the farmers' cooperative or which she is member. She also sometimes effectively participates in the agricultural extension animal fattening program with the help of the DAs for technical support and credit from ACSI (as she has own land to access the credit service).

With this connection and background, she witnessed that tether and stall feeding for fattening and milking animals has a good impact on productivity, since the animals stay healthy at home and save body energy and efficiently convert the feed they eat. With this system, the small portion of her backyard land left for growing grass is more productive than with other crops, as she got multiple benefits from the cows (source of food, income, saving and manure). Nearby water source has also contributed much in managing such activities with her limited labor.

A nearby water source does not only alleviate labor constraints, but also saves energy and time that could be used for other productive activities like backyard fodder production. Such strategy, for instance, enables poor women farmers to keep dairy cow (s) and other small animals with relatively little effort and cost due to the availability of water and feed at the homestead. Hence, they will enjoy the benefits of better nutrition, income, and job opportunities. Poor men farmers also share the benefits, as they can fully concentrate on farm activities, while homestead activities can be handled by women.

Facilitating credit services can be a useful strategy to alleviate the financial problems of the poor women, especially in relation to large animals (e.g., dairy cow production), which need relatively high initial investments. It also enables poor young male farmers to rent in land from the other groups to buy draft power.

In general, women own little or no livestock and benefit less from the resource due to the various socio-economical limitations, as also indicated in van Hoeve and van Koppen (2006). Farmers who have enough land, draft power and human labor manage farming activities better and benefit from the available resources. Hence, they are able to involve in animal keeping and contribute to the improvement of the livestock production system, while other land- and labor- constrained households may not be capable of doing so, even if they have the motivation. Thus, empowering these groups is vital to make them participate in the LWP programs.

Livestock interventions, their impacts and gaps

Livestock interventions in the study sites mainly include management measures with relation to animals and their feed. Even though the interventions have not been as effective as expected, some efforts markedly have contributed to improve productivity. The following interventions can be mentioned as examples (for details, see Table 2.1 and 2.2).

Feed management interventions, such as area closure in *Lenche Dima*, have not only improved the feed source but have also played a significant role in minimizing soil and water erosion. This in turn enabled the farmers primarily to be productive in crop production and minimized the loss of animals due to flood. The enclosed area distributed to

the poor and landless farmers also notably contributed to access to land and animal feed. But, on the other hand, it affected the goat production by minimizing browsing areas.

In *Kuhar Michael*, the closure of the communal grazing land (initiated by IPMS/ILRI in collaboration with the woreda agricultural office, livestock department extension program) has also protected the grass, which before was lost due to mismanagement and through the trampling damage by animals during the rainy season. Nowadays, farmers get additional feed, which they can conserve for the dry season. The other intervention like the urea treatment of rice husks by IPMS/ILRI and the agricultural extension program also plays an important role in improving milk production and has led to an increase in the milk yield from 0.5 to 2 liters/day/cow (Box 3). Moreover, the efforts made to use tethers and a feeding system especially in the dry season and around midday contributed to saving energy of animals and thus improved their feed conversion efficiency and productivity. However, in some cases, it meant all additional workload for women, children and men at the homesteads. The other interventions include fodder production and private grazing land management, which are very limited in *Lenche Dima*. This helped the farmers in securing feed for the dry season and can be considered as a means to integrate livestock keeping with improved feed management and fodder production.

Animal management interventions mainly include animal fattening (cattle, small ruminants and camels in *Lenche Dima*) and small ruminants' production packages in general, and breeds improvement schemes especially in dairy development, poultry production and bee keeping through providing improved animals and beehives. Breed improvement interventions have, however, not successfully contributed to livelihood improvement as intended due to different factors among which especially feed and management cost for improved breeds and hives have to be considered.

All in all, the research findings indicate that there are considerable changes in the livestock system at both research sites, which have positive and negative gender implications as well as productivity and livelihood impacts (Chapter 5). The shifts and their implications for different gender lines and wellbeing classes include:

1. The change in the feeding system has added to the workload and burden of women at home, especially in labor-constrained households, while it has made it possible for children to attend school. However, its contribution to enhancing women's productive role in livestock keeping should not be undervalued, as it is an opportunity to empower and enable women to participate in livestock programs and improve their livelihoods. On the other hand, if farmers well adapt the change, it will create an opportunity to upscale area enclosure to other degraded areas. Nonetheless, the change in the feeding system also has negative consequences; i.e., decreasing livestock productivity and re-productivity due to too low energy supply for normal physiological activities, forced culling of animals that minimize herd size and diversity at household level resulting in reduced income. Hence, its contribution to livelihoods improvement is minimal.
2. Feed sourcing change, i.e., dependency on crop residue, on the other hand, led to both problems and opportunities for share croppers of poor men- and women-headed households. Landless farmers got the opportunity to access crop residues through share cropping, while land renters, without crop residue share arrangements, were not benefited. Crop residues are then not available for other uses such as for fencing, house construction and fuel source. Especially women are affected as they use crop residue for cooking fuel in their domestic role. Feed conservation like hay making and the purchase of feed can be used as a strategy to encourage irrigation users to produce animal feed for the market during the dry season. But associated problems are poor nutritive value of crop residues, financial problems when purchasing feed, and a reduced feed amount and feeding frequency due to feed shortage, which again affects the productivity of livestock and its contribution to livelihoods.
3. The use of other feed sources like marginal lands and restricted areas has impacted animal health, social networking and environmental wellbeing due to increasing degradation. In such cases, both men and women will be exposed to additional costs for medication and keeping good social networks by avoiding individual conflicts with neighbors.

4. The strategy of keeping animals for the market has helped the poor farmers to diversify their income and has created job for the landless young farmers. Camels for example, can adapt to climate change impacts on feed and water availability, while small ruminants cost less and pay back faster than cattle.

The results of this study reveal that the livestock resources and livestock keeping activities are integrated with crop production, but that the poor are benefiting less from these resources as compared to the potential. This is due to limitations in accessing other assets and capabilities. Empowering the poor is critical, but there is a need to identify well-defined target groups for respective interventions. In addition, an integrated approach needs to be implemented with due consideration of different socio-economic strategies, rather than single technical interventions. In general terms, livestock interventions have to take into account determinant factors such as role/function of livestock in household livelihood objectives, ownership of/access to other assets like land, labor, finance, knowledge/skill, and livestock species of interest, processing and marketing of livestock and livestock products, household capability, and the cultural and institutional (social assets) contexts in addition to agro-ecology and production system.

6.1.3 Water and rural livelihoods: multiple use service (MUS) approach

In this section, the different sources of water in the study sites, their uses and gendered access are presented. Furthermore, the availability and seasonality of these sources for livestock and other uses are described. The different water development interventions introduced at the study sites and their impact on improving productivity and livelihoods are discussed in relation to multiple use system (MUS) services. Finally, the identified gaps and their implications for intervention are analyzed.

In rural areas, people use multiple sources of water for a wide range of essential activities (both for domestic use and productive activities) in their multiple livelihood strategies. Livestock keeping is central to the mixed crop-livestock system that has both domestic and productive roles in rural poor livelihoods, even though it is often considered as water consuming and land degrading. This adverse effect is aggravated by the

cumulative effects of climate change coupled with increasing demands and uses of water as a result of ever increasing human and livestock populations. Water scarcity has became more challenging in the rain fed, mixed agricultural systems of the arid and semi-arid areas of the Amhara highlands such as *Lenche Dima*, where, as depicted above, climate change impacts mainly mean failure of *belg* rains combined with increasing temperatures.

Considering this situation, among multiple opportunities, strategic provision of livestock drinking water in this system has been suggested to improve water productivity in general and livestock water productivity (LWP) in particular (Peden et al. 2007, 2009). This could be achieved through integrating livestock into crop production and water development interventions applying the intermediate level of the MUS approach (section 2.2.3) including respective gender implications. This has been neglected in the previous and currently working interventions and although it is central to LWP improvement (van Hoeve and van Koppen 2006: 18).

Multiple use of water can be accommodated within or included in the existing structures of irrigation, domestic use and other water use systems by adapting different technologies, ways of uses and improving services in order to maximize benefits from the same source (Sandy and Sarah 2006: 3). However, to implement this approach it is important to thoroughly understand the realities of the current system. In light of this, and targeting at water/livestock productivity and gendered livelihoods improvement in the system, this section presents the findings based on three specific issues: 1) the existing gendered multiple use system, 2) its gaps in relation to water productivity particularly livestock water productivity, and 3) the entry points to promote gender sensitive WP/LWP interventions through identifying multiple-use options and targets.

Water sources, purposes and gendered access in *Lenche Dima* and *Kuhar Michael*

A comparative analysis of water resources, uses, gendered governing processes, and gaps in the use system revealed that water resources in the study sites are of different types. Farmers use a single source for multiple purposes or use multiple sources for single purposes (Table 6.12). It was observed that farmers mainly use water from the rivers, springs, hand-dug shallow wells, and deep well, piped water for domestic use (drinking,

cooking and sanitation). This use system (single use from multiple sources) is a result of uneven spatial and temporal distribution of the different sources.

On the other hand, farmers use a single source of water, the river for instance, for different purposes such as irrigation, livestock watering and sanitation purposes without using any separate structure. This might carry the risk of human health problems due to pollution and irrigation infrastructure damage. Water from hand-dug wells and harvesting structures is also used for domestic purposes, livestock watering, gardening and fodder production (irrigation). Thus, the use of single sources for multiple purposes and use of different sources for single purposes are in place in both study sites.

However, due to the traditional use of the sources by the farmers (way, amount and timing), the desired output has not been obtained with respect to productivity, sustainability of water structures and water availability. Moreover, these water sources have their own limitations regarding provision of multiple use services. Some of the water structures are not properly functioning and they are not usually fixed in time due to mismanagement and weak governing institutions coupled with lack of motivation on the part of the users (section 6.1.5).

Table 6.12 Water sources, gendered access and direct use at village level in the study sites

Sites	Water source	Water use	Gendered access	Development works
Villages in *Lenche Dima* (*Kolokobo* and *Oromo sub-kebeles*)				
KoloKobo	1 natural pond	Livestock watering	Ch/M	
Urenew	2 rivers	Livestock watering, sanitation	M/W/C	
Addis Kebele				
Gerado	4 manmade ponds	Livestock watering, sanitation	W/Ch	Pond development
Lenche Dima	1 deep well with 3 stand pipes	Domestic use (drinking) and livestock watering	W/C/M	Domestic water supply deep well and stand pipes
Worekyu	20 water Harvesting Domes	Gardening, livestock watering and domestic use, especially for sanitation	M/W/C	Water harvesting development work by AMAREW
Tuluba Deme Gurguad Kebele	1 river	Irrigation, livestock watering and domestic use	M/W/C	Irrigation canal development
Qile Gora Debiso	5 manmade ponds	Livestock watering	C/M	Pond development
Bole Chaka Sefed Amba	1 deep well with 2 stand pipes	Human drinking, livestock watering, sanitation	W/C/M	Domestic water supply, deep well and pipes
Abahulagenda	1 spring	Domestic use	M/W/C	Spring enhancement
Villages in *Kuhar Michael*				
Mesno	River	Domestic use, livestock watering and irrigation	M/W/Ch	
	Borehole pipe water	Domestic use, especially drinking	W/Ch/M	Water supply development by FINNIDA
	Hand-dug well	Domestic use, livestock watering and gardening	W/Ch/M	
Nora	Natural spring	Irrigation/gardening and sanitation	W/Ch	
Mender	Spring piped water	Domestic use and livestock watering	W/Ch	Spring enhancement
Aqabit	Spring	Domestic use and livestock watering	W/Ch	
	River	Irrigation, livestock watering and domestic use	M/Ch	Canal development by SEARAR and ORDA
Barage	Borehole pipe water	Domestic use, traditional irrigation, livestock watering		Water supply development
Shehety	Spring piped water	Domestic use, gardening and livestock watering	W/Ch/M	Spring development
Adabit	Spring piped water	Domestic use and livestock watering	W/Ch	Spring development
	Deep well piped water	Domestic use, especially for drinking	W/Ch	Water supply development

Source: Author, computed from secondary source (DAs and Woreda water sector)
Note: M=Men; W=Women, Ch=Children

Availability and seasonality of water sources for livestock keeping and other uses

With manifold uses, water is an important input in livestock keeping. For instance, access to irrigation provides the opportunity to produce not only dry season crops, but also green feeds, crop aftermath, crop residues and fodder from farm boundaries. In addition, drinking water will be available for livestock from the irrigation canals/river upstream, though this is not formally allowed in the irrigation system.

Water sources, their availability, and ways of uses are not the same in the two study sites, but there are some overlaps. There are also variations between gender lines in using a source for multiple purposes. Women use water from developed springs for domestic purposes including livestock watering. But men only use spring water for domestic consumption. River water, on the other hand, is used for irrigation and livestock watering by men and by women for sanitation purposes.

Farmer communities in the study sites obtain water from three major sources: rain, surface, and groundwater in different modes of provision. Rainwater is basically used for crop production, livestock watering and sanitation purposes, surface water from ponds and springs is mostly used for livestock and sanitation purposes, and water from rivers is used for irrigation and livestock watering. Households in *Lenche Dima* use clean deep-well piped groundwater for domestic purposes, whereas in *Kuhar Michael*, they use different sources including borehole hand-pumped water. The sources of livestock watering water in *Lenche Dima* include wetland (Hara), Alwuha and other seasonal rivers (Wurenew/Yibar and Cherety) and communal ponds located at six villages (Figure 6.5 and Table 6.12). In *Kuhar Michael*, farmers use rivers and groundwater for livestock watering.

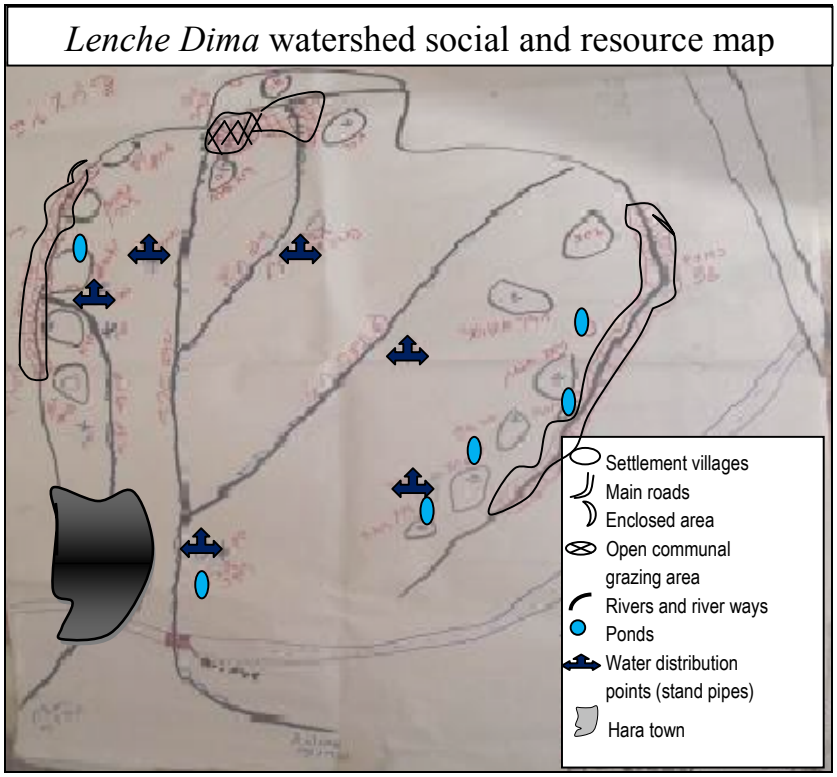


Figure 6.5 Map of *Lenche Dima* watershed showing resource distribution (picture taken from social and resource mapping exercise with some add-ons).

As to availability and seasonality, the two study sites were found to be different. In *Lenche Dima*, the main rainy season is currently shorter in the course of climate change, i.e., a maximum of two months (Chapter 4). Using ponds, the rainwater serves as livestock watering source from July to December. The period may further extend to April/May in years when there is rain in January. In general, the ponds remain filled with rainwater for 9 to 10 months (Figure 4.3 in section 4.1.3).

Likewise, clean groundwater from deep wells is available throughout the year, especially for domestic purposes. Hara wetland is another water source used throughout the year, with the exception of May and June in the absence of *belg* rains during April and May. In addition to livestock watering, the water is also used for threshing area preparation, sanitation purposes and domestic uses, especially during the dry season.

Farmers in *Lenche Dima*, who are closer to the Alawuha irrigation scheme, have access to irrigated land through the tenure system. Alawuha River is the water source for

the scheme, which is shared by the *woreda*s: *Kobo* and *Laste Gerado*. The users of the scheme can provide their animals with green feeds and drinking water from the canal and nearby wetland during the dry season. Farmers who have a nearby water source such as run-off water harvesting structures or groundwater wells or protected nearby natural ponds make it easier to get enough drinking water for the animals and to save their energy, time, and labor (for *Kuhar Michael* see Table 6.7, for *Lenche Dima* see Figure 4.3 in section 4.1.3).

The run-off water harvesting technology introduced by AMAREW (since 2005) is used as a dry-season water source. Those well performing structures help farmers to grow backyard fruit trees and vegetables for sale, and secure water provision for livestock and domestic uses. But due to recurrent droughts and little rainfall, the structures could not harvest and store enough run-off water. As a result, dry-season livestock water shortage still remains a major problem in *Lenche Dima*, especially during November (in bad years) and gets worse in May and June. In such times, those farmers who can afford it use piped water for their livestock, while other groups use different far-distant water sources; piped water costs $ 0.012 per 20 liter (1 USD is equal to Birr 17). Women and children, especially girls, are responsible to collect water for both domestic use and livestock watering at home while watering livestock from rivers is men's and boys' responsibilities in both sites (refer to section 5.1.3).

Currently, ponds in *Lenche Dima* are shrinking due to the expansion of the surrounding farmlands and poor land management that has exposed the ponds to sedimentation. Around the wetland surrounding the pond, water-borne diseases like malaria and ameba affect farmers during September through October. Besides, internal parasites and worms attack the livestock during May through June. Ponds are causing multiple problems, since the community is not paying due attention to them, especially after the introduction of the domestic water supply. Most of the ponds are also poorly designed and managed, and hence cannot store enough water in times of good rainy seasons. Unreliability of rainfall in the course of climate change and loss of water through percolation and evaporation aggravates water availability in the area. High temperatures also increase animal water requirements.

In *Kuhar Michael*, farmers use different water sources for multiple purposes. Mostly, rivers are used for livestock watering and irrigation purposes. Some farmers have access to clean water from public sources, while a few have private sources. Other sources like open shallow communal wells, ponds, springs and rivers are commonly used by almost all farmers. However, there are certain problems affecting the availability of water. Firstly, flooding occurs every year in the downstream areas during the heavy rainy season causing water-borne diseases. Moreover, this results in feed and water shortage due to muddy sediment loads in the grazing areas. Secondly, there is shortage of irrigation water from rivers during the dry season, since the water from the river is excessively pumped in the upstream areas. Thirdly, the upland areas suffer from shortage of water since rivers and springs have less water on the one hand, and the groundwater table is deeper and stony ground on the other hand. The plain areas share the same problems. Though the groundwater table is shallow and the water easily accessible, the fragile nature of the soil frequently causes the collapse of hand-dug wells through by heavy rains. This in turn affects the accessibility and best use of the groundwater for multiple purposes.

Water development interventions and contribution to LWP and livelihoods

Enhanced water productivity for livelihood improvement in rural areas includes a range of technical options to support different domestic and productive activities. In cropping, the interventions undertaken were from simplest on-farm water conservation practices in rain fed agriculture to the highest water conservation and control techniques in irrigation. Among many water-related interventions, livestock water interventions are the focus of this study. In livestock drinking water supplies, for instance, interventions can be shallow tube wells with different lifting mechanisms and the placing of watering troughs, spring diversion and water harvesting using water storage structures and micro-catchment water harvesting systems for rainwater run-off using the structure of contour bands. Improved drinking water technologies such as household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collection greatly help in the provision of safe drinking water (van Koppen and van Hoeve 2005). Annex Table 3 also shows water supply systems in Ethiopia.

In the study sites, interventions mainly include domestic water supply (boreholes, protected dug wells, and spring enhancement), run-off water harvesting and pond construction. Irrigation, rice introduction in flood plains, and agricultural water conservation/management are the other efforts made to improve agricultural water and contribute to improvement of livestock water availability. However, most of them were targeted for single use. Hence, enabling approaches and technologies need to be implemented in an integrated manner in order to match the locally available water sources with the multiple needs of farmers' households. It appears that such initiatives have received little attention in the past water system development works. The different water development interventions introduced in the study areas along with their impact on livelihood improvements are discussed as follows.

Water development interventions and their impacts in Lenche Dima

The interventions generally include development and management of domestic water supply and agricultural water. Domestic water supply schemes were introduced by UNICEF in collaboration with the AMAREW Project through groundwater development (deep borehole, piped supply systems). This primarily solved the problem of potable water supply for domestic use in a gender-equitable way at community level. This provision of safe and adequate water at a nearby distance helped especially women and children to save time and energy and improved sanitation and health at household level. As a result, women had the time for other activities at the homestead, while children got relatively a better chance to attend school. Men were also partly relieved from driving their animals to distant water sources. Even though the degree of the impact varies among households and gender lines, the intervention notably contributes to improvement of the livelihoods of the community in general and the households in particular (see Figure 6.6).

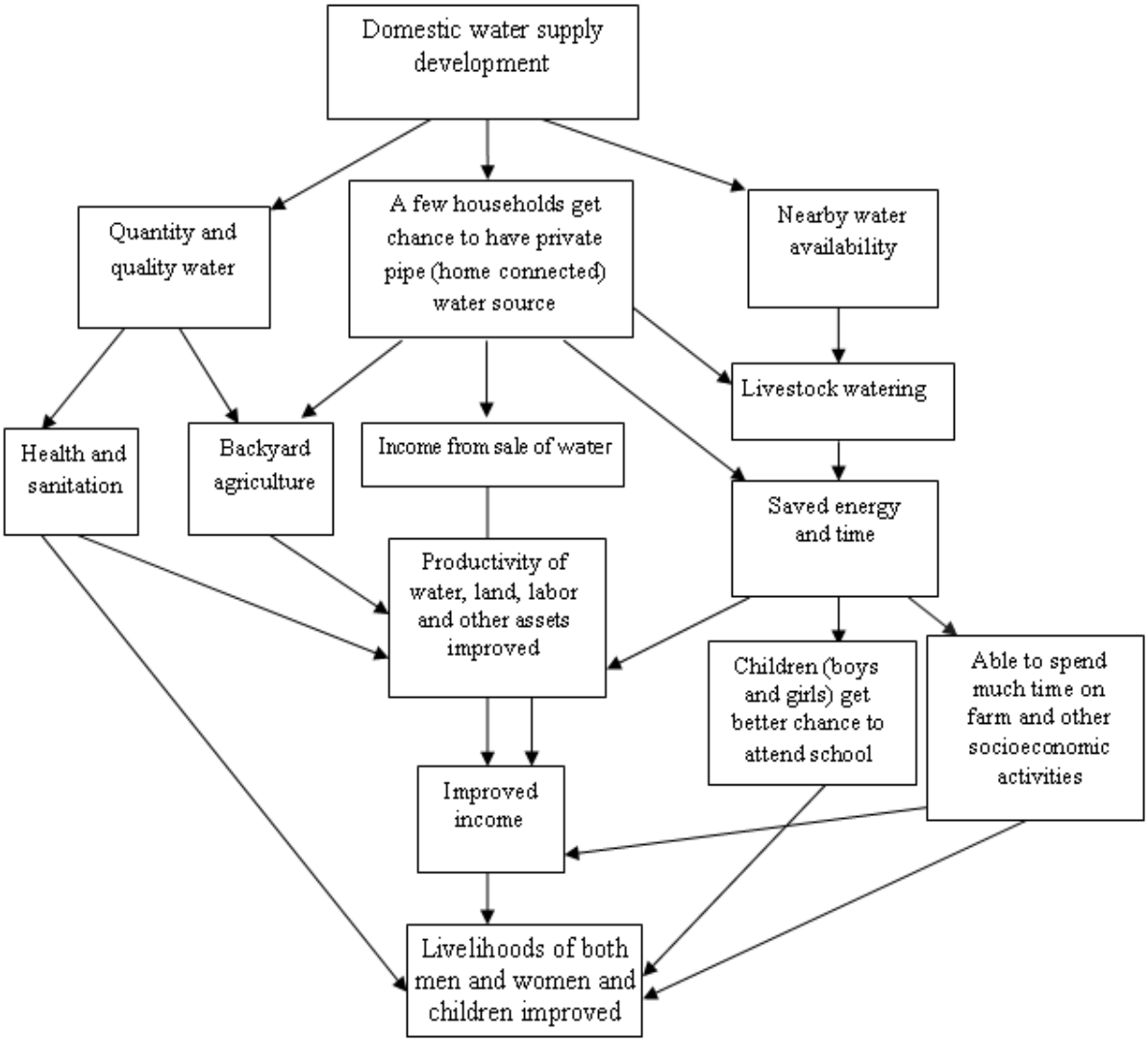


Figure 6.6 Domestic water supply interventions, contribution to farmers' livelihoods in *Lenche Dima (*drawn from impact diagramming exercises and group discussions).

The intervention not only contributed to satisfy domestic needs but also improved livestock productivity at the site; farmers used the system as a source of water for livestock and gardening. However, due to the absence of livestock watering troughs, farmers usually used plastic containers to water animals at the point of water distribution, which caused soil distraction around the watering points. With the domestic water supply system, a few households gained access to home-connected pipe water sources. Such service, however,

was confined to specific villages (Addis *Kebele*, which is adjacent to the town of Hara and Urenew). It provided households with quantity and quality water for multiple purposes. With home-connected pipe water, some farmers grow fruit trees and vegetables, thereby improving their nutrition, income and wellbeing from supplemental productive activities (Box 3). Moreover, due to this intervention, the responsibility of livestock watering shifted from men and boys to women at nearby watering points, and water fetching for domestic use was totally left to women and children.

Box 3: The multiple uses of water-harvesting domes and home-connected pipelines

A) Water harvesting dome and home-connected pipe water in a household for multiple purposes including livestock keeping

B) Water harvesting dome with drip irrigation for growing fruit trees and vegetables

Desale Belete Gobena is an illiterate poor farmer, 72, who lives in *Kolokobo in Lenche Dima*. With three working family members, he owns about 2.5 ha of land and shares grassland from the enclosure (0.25 ha). He has been using a water harvesting dome for growing fruit trees and vegetables since 2005. Accordingly, he was able to grow 116 chat, 8 oranges, and 90 coffee trees, and many eucalyptus trees. But, in 2009 the dome went dry due to drought and insufficient rainwater runoff. In order to alleviate the water scarcity and protect the trees, he looked for other water sources and invested in home-connected pipe water, which he found to be too costly to use for gardening. In this connection, he was able to secure a loan of 1,490 Ethiopian Birr from the PSNP to buy the pipe. His son assists him in handling outside farming while he takes care of the gardening activities. Currently, he has only one cow with a calf since he sold the others as well as draft oxen to pay for a new iron-sheet roofed house. As a result, he is engaged in gardening and he grows vegetable crops like onions, tomatos, garlic and others for the market. But this year, these crops suffered from drought although supplemented with irrigation water. The farmer is still under the safety net program and enjoys the service. In the upcoming period, he is planning to expand and diversify his business by growing more trees, keeping bees and other animals with the help of the technical and financial support from the government. He is considerably benefiting from the intervention.

Pictures in Figure 6.7 show how access to water for different purposes varies compared to before and after the domestic water supply intervention in *Lenche Dima*.

Figure 6.7 Water accessing for different uses before and after the domestic water supply development intervention in Lenche Dima (pictures in the left show other sources while the right show the developed domestic water supply system) (pictures taken in 2008).

Notwithstanding its remarkable contributions, this intervention has the following gaps in relation to livestock water productivity and livelihoods improvement. These include:

1. The water distribution points (at 6 places in the watershed including stand pipe at the main tank) were designed to serve a single use system, i.e., only for domestic purposes. However, people are also using the system for livestock watering around the distribution points using plastic troughs, even if thus is formally not allowed.

2. There are no additional structures like troughs for either livestock watering or washing clothes to diversify the use of the resource. It was observed that the existing watering trough placed in the main tank area (Figure 6.7 right bottom) is not functional.
3. In most women-headed households, the home-connected pipe water still serves domestic purpose only; there is no integration of either gardening or livestock.

The other intervention in *Lenche Dima* is rain-water (run-off) harvesting in cylindrical cemented domes introduced by the AMAREW project targeting multiple purposes, i.e., domestic use, livestock watering and gardening. It was learned that this intervention has greatly contributed to water and livestock productivity through providing relatively clean and sufficient water at homestead level, saving time and energy of children, women and animals. As a result, women have time for backyard farming (and hence improved food and income), and children can better attend the school. However, this water harvesting technology was not found to be gender equitable in terms of participation at community level. It only comprised 19 men-headed farmer households, even though women in these households benefited by saving time and energy at household level (Figure 6.8).

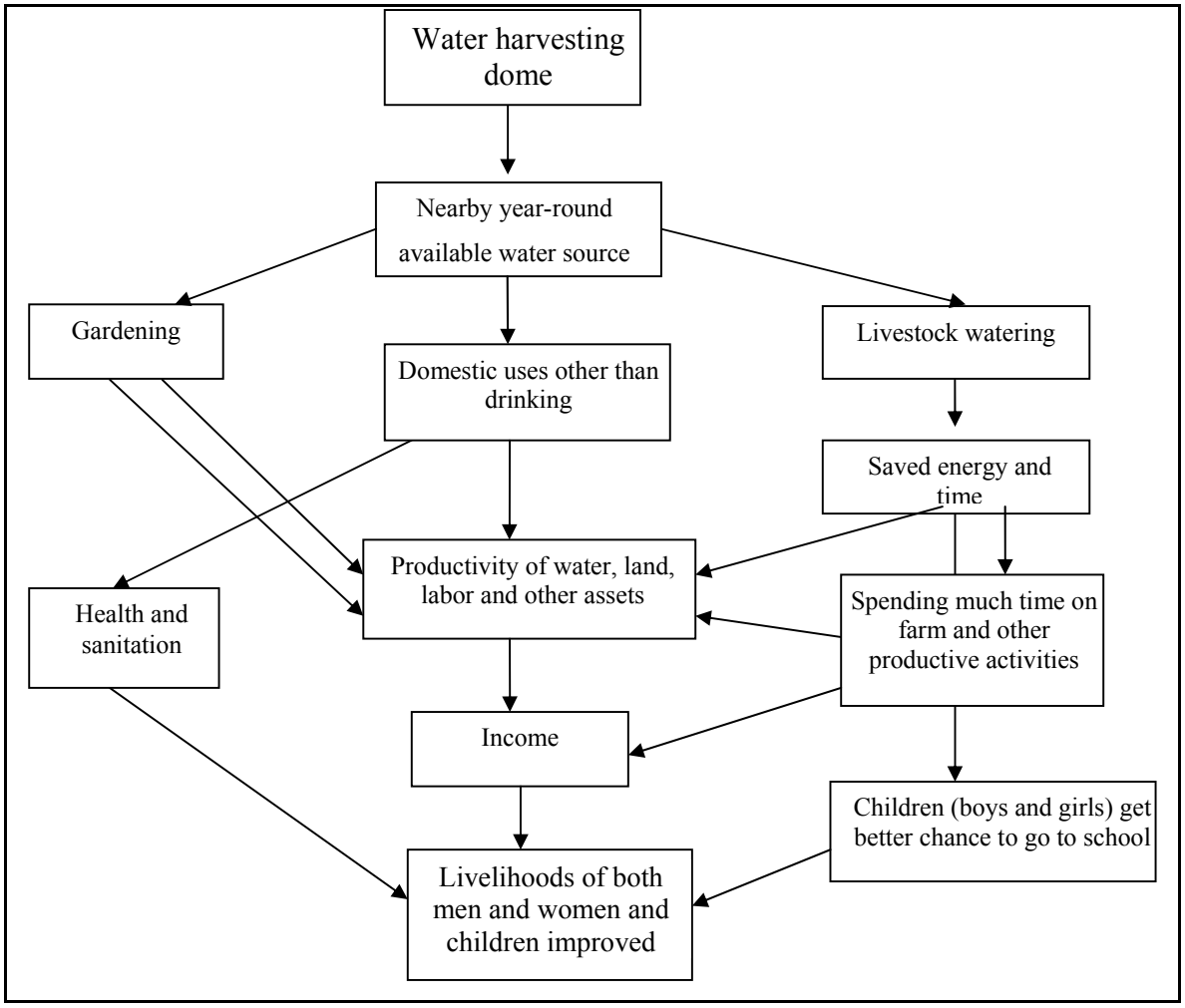


Figure 6.8 Run-off water harvesting intervention in farmers' livelihoods in *Lenche Dima* (drawn from impact diagramming exercises and group discussions).

On the other hand, most farmers are not willing to adopt the technology due to the climate change effect of drought and shortage of rain. In this connection farmers said "…*it was good to have water throughout the year for multiple purposes at nearby places, but without rain and without enough runoff to be harvested, there is no need to invest energy to excavate for water supplies*." Thus, it is important to look for alternative sources like groundwater or to upscale the technology in good seasons with a gender-equitable approach for a sustainable water supply in the area. The water productivity improvement interventions, if implemented effectively, would benefit both men and women farmers of

poor households. However, the financial gap will still be a problem for poor households unless resolved through a credit system.

Irrigation is the other agricultural water improvement intervention introduced by SEARAR in *Lenche Dima*. In the context of the Alawuha irrigation system (river diversion), about 1,026 registered households have access to irrigation, out of which 38 % (350 households) are from the *Lenche Dima* watershed. About 65 % of the participants use the traditional system, while the rest applies the modern system where water distribution is through a controlled canal system, unlike the traditional practice. Women-headed households account for about 35.5 % of the traditional system[18] and 18.6 % of the modern scheme[19].

By using the irrigation access, farmers produce two/three times a year. They also produce vegetables (onions and tomatoes), which were newly introduced together with the scheme and have a high market demand. Generally, the productivity of farmland and labor has improved, resulting in better income and household wellbeing. Moreover, due to the year-round crop production, animal feed is relatively more available throughout the year.

In this irrigation system, however, various problems were observed including problems of water use conflicts and theft, crop damaging by wild animals, uncontrolled grazing, canal destruction and little cooperation of users in the maintenance. Besides, water shortage is created in two ways, i.e., by the excessive use of water at the upstream locations and the situation in which all farmers simultaneously use a large amount of water for single cropping.

[18] Traditional irrigation system refers the use of irrigation to complement rain fed agriculture, and mostly to produce vegetables, fruit trees, and secondary crops (in *Kuhar Michael)* using the residual moisture and supplemental irrigation. Farmers design and construct the earthen irrigation canals by themselves. The system (water distribution and maintenance activities) is managed and coordinated by communally elected comittee called water fathers-mostly 2 elders in the case of the study sites.

[19] Where as, modern scheme refers to irrigation used to grow vegetables and cereal crops such as maize during the dry period. Farmers use well designed and cemented canals constructed by development agents such as SEARAR and ORDA. The system is managed by Water Users Association, which has a committee with 14 members.

Water development interventions and their impacts in Kuhar Michael

Among the different water-related interventions, irrigation with new horticultural crops (like onions and tomatoes), domestic water supply development and rice introduction are the major interventions at this site. These interventions have played a significant role in enhancing both crop and livestock production and hence livelihoods of both men and women farmers.

Like in *Lenche Dima*, irrigation in *Kuhar Michael* is of two types: modern irrigation since 2000 and the traditional since the resettlement time in1982. Data collected from secondary sources indicate that a total of 710 registered farmer households (60.5% of the *Kebele* total) have access to the irrigation scheme, out of which 101 farmer households (12 women headed) use the modern system, whereas 609 farmer households (20 women headed) use the traditional system.

Farmers employ the river diversion/pumping system, hand-dug wells using the rope and bucket system, ponds and spring water for irrigation (see Table 6.12). Such irrigation system enabled poor farmers to improve their land and labor productivity and thus maximize benefits from their limited resources. It also contributed to the availability of year-round food/feed (Figure 6.9 and Table 6.13).

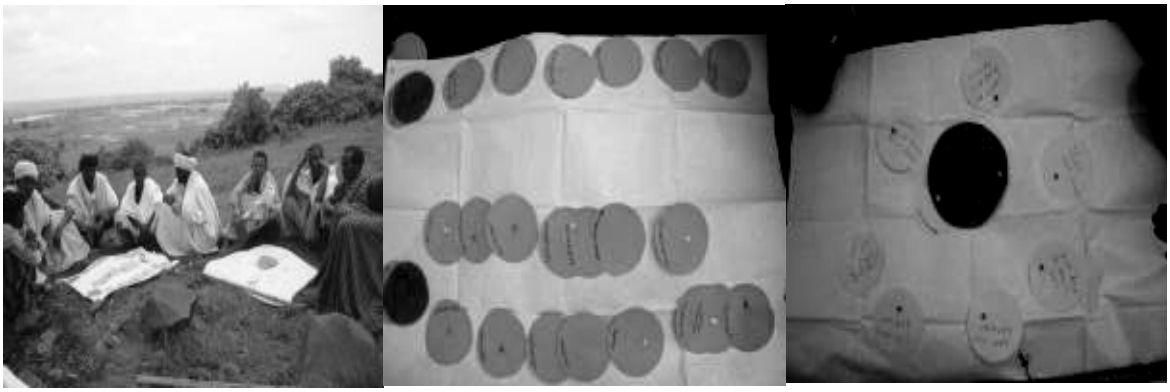


Figure 6.9 Irrigation impact diagram (pictures taken in 2009).

Table 6.13 Impact of irrigation on farmers' livelihoods (drawn from impact diagramming exercise and group discussion)

Irrigation impacts on participants		**Irrigation impacts on non-participants**
Before 1999/2000	**After 1999/2000**	
Crop mainly teff and maize, only once a year	Crop growing shifted to rice in wet season; also tomatoes, potatoes and onions are produced 2-3 times/year.	Limitation/lack of access to irrigable land
Income was not satisfactory because traditional systems were used, even for irrigation from the river	Better income, especially from marketable crops like onion, tomatoes and rice	Low income due to low productivity as farming is rain dependant
Food insecurity for few months, highly vulnerable to stresses	Food security throughout the year for the household, even during stress times	Food insecurity for a few months, highly vulnerable to stresses
Could not fulfill basic needs	Easily fulfill basic needs	Could not fulfill basic needs
Could not own oxen and buy farm inputs like fertilizer	Able to buy farmland and inputs like oxen	Could not own oxen and buy farm inputs like fertilizer
Unable to send children to school	Able to send their children to school since they can hire laborers if the need arises	Unable to send children to school
Unable to build other assets, like livestock	Able to build/add more assets like livestock (milking cows), water pumping motor, grain-mills, savings	Discouraged to buy another animal
Unable to access new technologies	Started to use technologies like mobile phone, radio, etc.	Unable to access new technologies

As can be learnt from the exercise, irrigation notably contributes to income and livelihood change in the *Kebele* following rice introduction. However, it was designed for single use purpose, and there are some conflicts in the water use, distribution, and management practices.

The other intervention at the site is the domestic water supply development introduced by FINNIDA in collaboration with the regional water bureau. The technology includes boreholes with hand pumps, cemented shallow wells with rope and bucket system, and spring enhancement (Figure 6.10 except (a)).

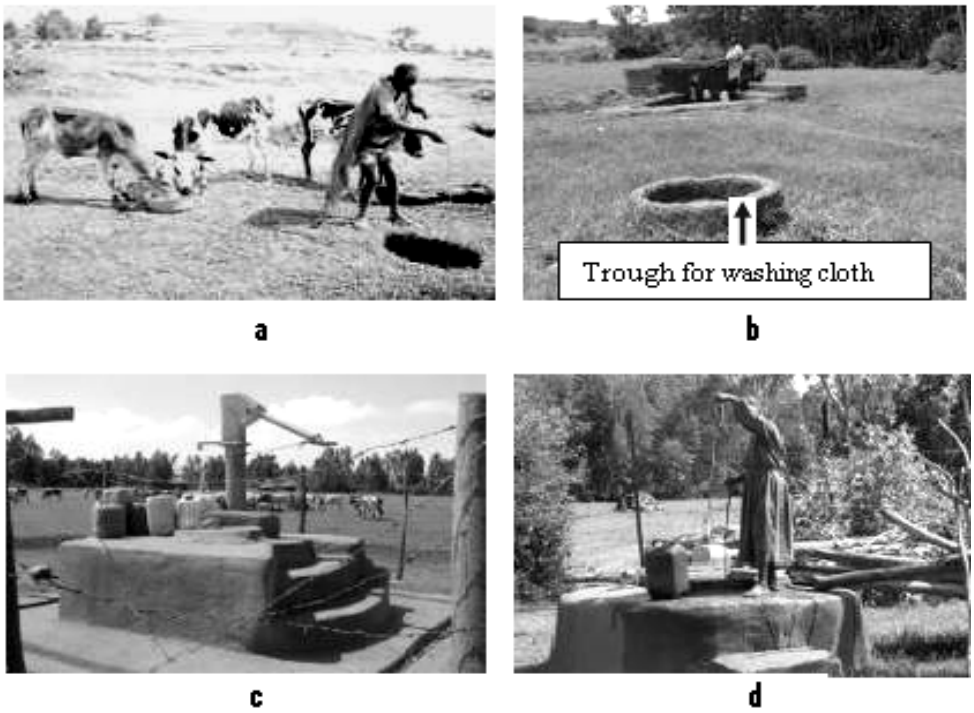


Figure 6.10 Water sources and water development interventions (pictures taken in 2008) (a)=Hand-dug shallow pit for livestock watering; (b) =Spring water enhanced for domestic use; (c) =Borehole with hand pump (domestic use); and (d) =Rope and bucket shallow well (domestic use)

In short, these water development interventions have contributed to meeting the need for clean water for domestic use, and have improved health and sanitation and saved time and labor for women and children. In spite of these benefits, all systems have their limitations in delivering water supply services for multiple purposes. It was observed that in all the structures a livestock watering place was missing, even in the ones constructed close to/at grazing areas (Figure 6.10 (c)). On the other hand, the spring enhancement effort is constrained by lack of control or reuse system for the flow-off water. This also requires a mechanism to minimize such wastage through water reuse or a storage system. Also, the

small hand-dug pits on communal lands (Figure 6.10 (a)), and some of shallow cemented wells are open and mostly unprotected, which bears the risk for the health and lives of the people and animals and thus needs attention from the livelihood security point of view.

As a result of the rice introduction in the flood plains, considerable improvements were observed in the farmers' livelihoods and the environment in general. Farmers in *Kuhar Michael* witnessed that rice introduction has gradually changed their livelihoods in many ways. It is to be noted that it was originally introduced in 1982 during the Derg regime by an individual and practiced by few farmers working in the existing cooperatives. It was then further expanded to other farmers by the help of *Woreda* extension experts (Figure 6.11).

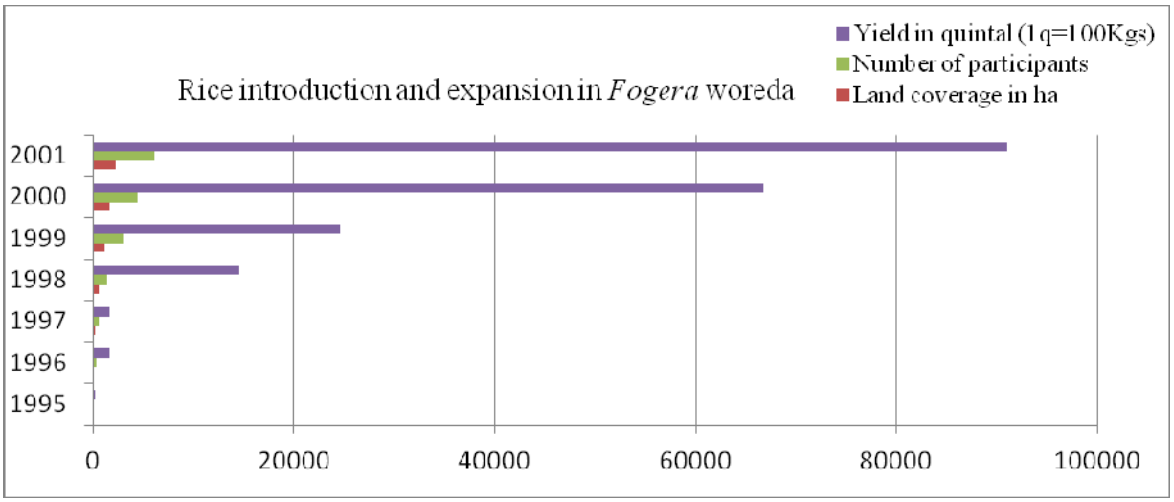


Figure 6.11 Rice production expansions in *Fogera woreda including Kuhar Michael* (computed from data obtained from the Woreda agricultural office).

Currently, rice is widely cultivated in the plain land benefiting more than 50 % of the farmer households in *Kuhar Michael,* and is serving as a source of food, feed, and cash income. Rice nowadays covers more than 60 % of the crop residue. Rice productivity in a unit area is about 4 fold higher than teff, while both have all almost equivalent market prices. Due to its high market value and demand, rice is dominating other crops and becoming the single most important crop replacing teff, noug, and millet in the crop

production system (Aredo et al. 2008). But it is labor intensive, especially regarding weeding.

The other important issue is that rice can be cultivated in areas that are affected by flooding. The flooded land has become useful and productive. This, in turn, has reduced the yearly migration of farmers during rainy seasons to the uplands, and thus has minimized the population pressure in the uplands. The labor required during weeding, harvesting, and post-harvest processing and marketing activities also provides job opportunities to other farmers in the locality. In general, rice introduction has a positive impact on land use, productivity of land, water and other assets, livestock productivity, income of farmers and livelihoods. However, it has been recognized that paddy rice cultivation has a considerable contribution to methane (CH_4) and nitrous oxide (N_2O) emissions and was increased greenhouse gas production, which can contribute to 20 % of the world methane emissions (Matsuno et al. 2006: 195; USEPA 2011: 6.12 – 6.13) , a concern of global warming or climate change.

Seen from the gender perspective, this intervention has benefited men and women farmers with respect to food, feed and income at household level. But, as it is highly labor intensive, it is a challenge, especially for poor men and women farmers. But, adapting labor- saving technologies like herbicides, which are used to control weeds (a determinant factor in yield/productivity improvement) can help to minimize labor requirements for weeding though the poor cannot make use of more inputs due to the high costs. Such inputs also have environmental impacts, e.g., water pollution (FAO 2002: 76)).

Despite the fact that rice residues cover a significant portion of the animal feed requirement in the bottom flat areas of *Kuhar Michael*, its palatability is lower as compared to teff straw and thus needs treatment. In this connection, urea treatment has been already started and tested on indoor dairy cows with the help of IPMS-ILRI office and in collaboration with the livestock department of WoARD. The test proved that the technology improves the palatability of the residue and at the same time improves milk production from 0.5 to 2 liters/day (Box 4).

Box 4: Rice residue treatment for increased milk production in *Kuhar Michael*

Sisay Agmas is a farmer living in *Kuhar Michael*. He went to school up to the third grade and managed to send three of five children to school. With a total family size of seven, he owns only 1 ha (4 kedama) rice field that is rented out due to lack of draft oxen. As to livestock, he possesses 2 cows, 2 goats, 1 donkey, and 3 chickens.

Currently, he is engaged in backyard farming (mainly maize growing) including the production of some vegetables for consumption and the market using water from communal sources like rivers and springs. During his spare time, he makes and sells constraction wood as an additional source of income. The family depends on share arrangements for their annual food requirements, but they are vulnerable to stress due to the absence of extra products.

Asked about the livestock contribution to his livelihood, he replied: "I am earning some cash from my cows and goats that spend the day time in the upland bushy grazing land. I also use the crop residues, which I obtain from a share cropping arrangement, for my cows as supplementary feed. Since the urea treatment technology has been applied, I get improved milk production. I can personally witness that the urea treatment improves milk production from 0.5 to 2 liters/day/cow. This not only helped me to meet my home consumption needs but also generate income from the sale of butter (up to birr 50/week/cow).

Summarizing the findings reveal that in both of the study sites, livestock has not been considered in the domestic water supply or in the irrigation developmental works (except draft oxen in the traditional irrigation system in *Kuhar Michael*). Relatively speaking, the privately owned water sources like water-harvesting dome and home-connected pipes in *Lenche Dima* and hand-dug wells in *Kuhar Michael* comprise better multiple use system than the government water structures (hand pump and piped boreholes), spring enhancement and the canal irrigation systems. On the other hand, livestock drinking water is still scarce, especially during the dry season in *Lenche Dima* and the wet season in *Kuhar Michael*.

The domestic water supply structures in both areas are limited to single purpose system service with no livestock water troughs in place. Similarly, the home-connected pipe water in *Lenche Dima* in most women headed households is still solely used for domestic purposes. Rainwater harvesting domes, though used for multiple purposes, have limitations in coping with climate change. Moreover, they are unevenly distributed spatially and gender wise. In *Kuhar Michael*, open and unprotected hand-dug wells and pits have

exposed both humans and livestock to risk of injury and thus need protection. Spring enhancement has led to uncontrolled water flow resulting in wastage, which needs to be minimized through integrating the system with grazing land improvement.

Accordingly, this study reveals that the use of the MUS approach like "domestic plus" on the domestic water structures is vital for an effective implementation of water development interventions on both the community level and household level. More specifically, placing watering troughs at strategic locations in the grazing areas in *Kuhar Michael*, and at water distribution points in *Lenche Dima* could improve livestock watering access, but these structures need to be protected from too many animals at a time and from other rivals e.g., wild animals. The inclusion of troughs for sanitation purposes would also help women and men to save time and energy. The integration of backyard farming of vegetables, fruits and fodder with the private water sources is also other concern for water productivity but this requires due consideration of economical factors that need to be analyzed. This approach would treat men and women farmers of poor households fairly. However, scarcity of resources like labor (for women headed households), land (for young poor men), and finance (for poor men and women) is a challenge. Groundwater development and scaling up of runoff water harvesting in good seasons using gender-balanced approaches will also benefit poor men and women farmers in *Lenche Dima*, despite financial limitations.

In *Kuhar Michael*, improving hand-dug wells with new technologies like cemented cylinders is another vital issue to access the potential groundwater source and improve clean water availability in the area. Integrating fishery with the paddy rice, which is widely used in Asia and India, might also be an option for improved water productivity and income, but here a further study of appropriate technologies and fish species is needed.

6.1.4 Livestock and water integration in the mixed crop-livestock system: gendered sustainable livelihoods approach (GSL) for targeting interventions.

This section discusses water and livestock integration in the study sites emphasizing their integration at household level. Every household has its own objectives, choices, priority needs, and limitations in relation to livestock keeping, though there are some common

group-specific choices/agendas. Thus, integrating water and livestock at household level in a gendered equitable way is a challenge if not well analyzed and targeted. In this respect, two key issues were considered: the enabling and disabling conditions of different groups of households and the responsive intervention options and targets for the LWP improvement program. In this section, the findings obtained from different household analyses including inter- and intra-household structures, characteristics and capabilities, livestock ownership and its livelihoods impact, households' resource governance and related interest/preference to keep livestock, and the qualitative cost/benefit analysis for keeping different types of animals and associated problems are described. Moreover, previously identified technical intervention options and targets (sections 6.1.2 and 6.1.3) are included in the discussion.

Gendered costs and benefits of keeping livestock and productivity improvement

Improvements in LWP through integrating water and livestock management can bring about a positive impact on poverty reduction, livelihoods, gender equity and environmental health. This can be achieved by duly identifying, characterizing and targeting interventions and participants and through enabling environmental, socio-cultural and institutional conditions. In addition to this, a cost-benefit analysis needs to be conducted. Costs and benefits of livestock keeping, integrated with water management, generally vary among sites, production system, wellbeing status and gender lines, animal type, feeding type, season and types of assets used.

Mostly, cost depends on the access to inputs such as water and land, which might be different for men and women. For instance, livestock keeping costs women-headed households more due to higher labor requirement for collecting feed and water and herding animals. Women in better-off men-headed households are relieved from livestock keeping activities since they use hired labor. The costs and benefits of keeping livestock vary by animal type, gender, and governing structure (access and control) in a household (Tables 6.14, 6.15 and 6.16). These can be considered as determining factors for the type and size of animals a household can keep and derive the required benefit.

Table 6.14 Matrix ranking for animal type preference by farmers' criteria in *Kuhar Michael*, (animal preference ranking exercise)

Preference criterion	**Livestock type**						
	Oxen	**Cows**	**Sheep**	**Goats**	**Donkeys**	**Chickens**	**Bee hives**
Labor need	2	2	1	5	1	1	1
Cost need (financial)	5	5	2	3	1	1	1
Benefit	4	5	2	3	5	4	5

***Note**: Ranking is from 1 (lowest) to 5 (highest)*

As per the ranking, cattle received the highest points with respect to benefit, but they are costly due to high costs of feed and health services. Keeping goats with other animals means higher cost as different types of labor are required, while the benefit is ranked moderate. It is known that goats do not graze together with other animals in the same field, unlike other groups (cattle, sheep and equines), which collectively graze with one herder. This being the case, goats are preferable due to their natural resistance to unfavorable environments, diseases and shortages of feed and water. On the other hand, the very useful animals such as chickens, bees (traditional beehives) and donkeys incur the lowest costs and labor to rear, but they get little attention from the farmers.

The costs and benefits of these animals also vary for men and women farmers in a household, which is an important factor to be considered in targeting gender sensitive interventions (Table 6.16).

The SLF considered five livelihood assets that comprise the basic productive and reproductive factors as component of the framework. The GSLF also considers five livestock-related livelihood assets (first column). These are necessary for keeping livestock, improving production and ensuring that men and women derive livestock-related benefits. The second column illustrates the costs required to access or utilize these assets. By making use of these assets, livelihood benefits are derived that include the reproduction of livestock asset (sixth column). The remaining columns indicate governing bodies of the assets and benefits in a household/community. It can be seen how gendered costs, access and control/use of different livelihood assets can be analyzed for specific animals using the GSLF.

Table 6.15 Gendered cost, benefits and related governing mechanisms involved in cattle rearing (computed from group discussion)

Assets	Costs	Access	Control	LS type	Benefit	Access	Control
N-L	Feed						
	- mainly grazing	C/M/	Comm.		Dung:	Comm/	M/C
	- crop residue	M/W/C	M		- Fertilizer	M/W/C	W
					- Fuel/cake		
	Water	M/C/W	Open				
	- rivers	W/C/M	Govt/WC				
	- public source	W/C/M	HH				
	- Private sources						
H-L	Grazing	C/M	Comm.	C	Meat	HH	M/W
	Watering	W/M/C	Open	A	Milk	HH	W
	Milking	M/W	HH		Butter for:	W/C	W
	Taking care of weak, pregnant and lactating cows, calves and kids	W/C/M	HH	T	- nutrition - health		
P	Veterinary	M/W	Govt/Pvt.	T	Draft power	M	M
	Water structure	W/M	Govt/WC	L			
	Shed - building	M/C/W	HH	E			
	- cleaning	W/C/M	HH				
F	Money to buy				Income from sale of:		
	-cattle medication	M	M		-Anl. products	W/M	W/M
	-feed	M	M		-Live animals	M	M&W
	-water	W/M	M/W		-Dung cake	W	W
S	Joint/exchange work	M	M		Fill labor gap	M	M
	Gift to married child	C	M&W		Pride	M&W	M&W
	Slaughter for festive	M & W	M&W		Meeting people	M&W	M&W

Note: *W=Women; M= Men; C= Children; Govt. = Government; Comm. = Community; WC= Water Committee, HH= Household, Pvt. = Private; Anl. Prodt = Animal products; Lb= Labor; LS= Livestock. N-L=Natural resources, especially land; H-L=Human resources, especially labor; P=physical, F=financial; and S=Social*

In keeping livestock, all assets mentioned are required, but their relative importance differs among agricultural production systems, animal species, cultures, gender, and wellbeing status. Differences between assets are not rigid, rather most are interrelated, overlapped, and convertible (van Hoeve and van Koppen, 2005). For example, the access and control over animal dung depends on the system and the type of crops grown, the

control of cultivation process, and the type of animal. Women are often involved in shed cleaning and preparation of dung, which is used for fuel as well as sale. Due to scarcity of firewood, farmers use animal dung and crop residues as fuel sources. Animal dung is also used for house construction and covering floor.

On the other hand, there is all overlapping nature of governance of assets by gender due to the existence of common responsibility for some activities in livestock keeping (Table 6.16). But there are also assets that exclusively incur costs and/or benefit men or women. Sometimes there are instances where some activities mean costs to one member of the household but benefit all or vice versa. Assessment of the costs and benefits of men and women in relation to keeping different animals indicate that there is no considerable regional difference in costs and benefits relationship for particular animals with the exception of a few religious-/cultural-related cases. But some variations were observed in costs and benefits for different animals among gender lines (between men, women and children).

For example, cows and small animals mean higher costs for women than for men, but the benefit men derive from these particular animals is relatively better. Men benefit more from oxen though the output will finally be used among all members of the household. Women can derive more benefit from donkeys and/or camels with low costs since the management of these animals is handled by men. It can also be observe that poultry keeping is exclusively handled by women as the benefit outweighs the cost. Cows and small ruminants are managed jointly by men, women and children, and the benefit (sale of live animals and meat consumption) will be shared among the household members.

Children are highly involved in herding (grazing and watering) of all animal types both at home and outside, but there is no direct benefit. Instead they indirectly benefit from the agricultural outputs, or they share benefits from the sale of live animals with respect to buying clothes and other basic needs, paying school fees, or getting medical services.

Generally, carful targeting of interventions is required with due consideration of the importance/value of animals for the different social groups, environmental and social friendliness of the animals and cost effectiveness for livelihoods improvement and gendered poverty reduction.

Table 6.16 Costs and benefits of livestock keeping by gender in the study sites

Animals	Men		Women	
	Cost	**Benefit**	**Cost**	**Benefit**
Cattle (Oxen)	- Time and labor for grazing and watering - Finance, labor and time for medication or veterinary services - Finance to purchase feed when needed - Finance and labor while selling, replacing, or exchanging oxen	- Draft power - Social value through joint work - Income when the animals are sold/replaced - Meat consumption, especially during holidays like Christmas, Epiphany, Easter, and Cross, in *Kuhar Michael* and religious festivity of Muslim community in *Lenche Dima*	- Labor and time for water and crop residue provision at home and domestic water points	- Obtain the benefits indirectly
Cattle (Cows)	- Finance for health care and veterinary services - Time and labor for grazing and watering (sometimes) - Finance to purchase feed when needed - Labor for milking - Time and labor for selling live animals when needed - Labor and finance for shed construction and cleaning (*Lenche Dima*)	- Replacement to oxen - Milk and butter consumption at home - Cash income from sale of live cows	- Labor and time for cleaning animals' places and dung management/making dung cake - Labor and time for milk processing and selling butter - Labor and time for taking care of pregnant/ lactating /sick cows and calves - Labor and time for feeding and watering at and close to homestead	- Cash income from sale of butter - Milk and butter consumption at home - Butter for cultural hair treatment

Table 6.16 continued

Animals	Men		Women	
	Cost	**Benefit**	**Cost**	**Benefit**
Sheep	- Time and labor for herding - Finance for health care and veterinary service - Time and labor for selling live sheep and skin	- Meat consumption(occasionally) - Cash income from sale of live sheep	- Labor and time for cleaning dung and taking care of kids/sick animals	- Meat consumption (occasionally) - Cash income from sale of live sheep
Goats	- Time and labor for herding - Labor and finance for health care and veterinary services - Time and labor for selling live goats and skins	- Meat consumption (occasionally) - Cash income from sale of live goats - Religious offerings in Lenche Dima	- Labor and time for herding, cleaning dung, and taking care of kids/sick/ewes	- Meat consumption (occasionally) - Cash income from sale of live goats - Religious offerings in Lenche Dima
Chickens	- Time and labor while assisting women in constructing night place - Time and labor for selling live chicken - Finance for medicine when needed	- Egg and meat consumption (occasionally)	- Labor and time for watering, feeding and looking after	- Egg and meat consumption (occasionally) - Cash income from sale of eggs and chickens - Strengthens social relations: presenting eggs as a gift on special occasions

Table 6.16 continued

Animals	Men		Women	
	Cost	**Benefit**	**Cost**	**Benefit**
Bees	- Finance to purchase colony - Labor, finance and time for constructing the stands and hives - Labor and finance for pest management - Labor for watering (sometimes) - Labor and time for harvesting and selling honey	- Honey serves as medication - Preparation of local drinks (occasionally) - Cash income from sale of honey and bee colonies	- Labor for hive plastering, assisting in watering, pest management, and sometimes harvesting	- Honey serves as medication - Preparation of local drinks (occasionally) - Cash income share from sale of honey and bee colonies
Donkeys	- Labor to protect animals from hyenas, theft, and damaging others property - Labor for providing residue from chickpea	- Transporting grains, residue, marketable items, agricultural inputs and water - Strengthens social relations while exchanging/sharing animal labor	- Labor to protect them from predators and theft, at home in the absence of husband - Labor for providing	- Transporting marketable items, grains, , and water - Strengthens social relations while exchanging/sharing animal labor
Camels (*Lenche Dima* only)	- Finance to acquire them - Labor, finance and time for feeding/herding and veterinary services	- Serves as social prestige - Transporting grains, residue, marketable items and agricultural inputs - Cash income from sale of live camels	- No cost	- Transporting marketable items, grains and water - Indirect income share

Table 6.16 continued

Animals	Cost and benefit of animals to children	
	Cost	**Benefit**
Cows	Children labor is used for grazing and watering outside homestead	Food consumption and income share from sale of the animals in different forms like school fees, clothing and health care
Goats	Mostly children take care of herding in the browsing area, sometimes assisted by men or in critical cases by women	

Farmers' capability, interest and preference of animal types

Farmers have their own way of valuing each animal species. Cattle in general were found to be the most preferred type of animal by all groups of farmer respondents. Most farmers tend to prefer oxen to cows, since oxen mean everything for crop production; farmers think they can easily acquire cows thereafter. Goats are the next more preferred animals by most farmers in *Lenche Dima* due to their adaptiveness to the environment; they can tolerate drought and thrive on feed available during the dry season. Likewise, farmers in *Kuhar Michael* also have their own preference of animals using their own mixed criteria.

Animal type preference primarily depends on the capability and interest of farmers and their access to basic resources. Besides, gender, wellbeing status and landscape contribute to selection of animal type. As per the group discussion and preference ranking exercise conducted, a farmer having labor and initial financial resources prefers to have a herd comprising a pair of oxen (for draft power), a good producing cow (for reproduction, milk production and saving) and a donkey (for transportation) in *Lenche Dima*. While the same farmer tends to prefer to have a pair of oxen (for draft power), 1 or 2 good performing cows (for reproduction, milk production and saving), 2 or 3 goats/sheep according to landscape (for reproduction or cash income) and donkeys (for transportation) in *Kuhar Michael* (Table 6.17, 6.18 and 6.19).

Table 6.17 Animal preferences in *Kuhar Michael* (preference ranking exercise)

Respondent category	**Livestock type**						
	Cattle						
	Oxen	**Cows**	**Sheep**	**Goats**	**Chickens**	**Bees**	**Donkeys**
Women (FH HHs)	7	6	4	3	5	2	1
Women (MH HHs)	7	6	3	4	5	2	1
Poor young male HHs	7	6	4	3	2	1	5
Other upland farmers	7	6	1	5	4	3	2
Other plain land farmers	7	6	5	1	4	3	2

Note: 1=least preferred, 7=most preferred; HH=Household; MH=Male-headed; FH=Female-headed

Table 6.18 Preference of animal type by gender and wellbeing category in *Kuhar Michael* (preference ranking exercise)

Animal type	Category	Rank of preference	Remark
Oxen	All class category	1st , for draft power	
Cows	Medium and better-off	2nd, for reproduction, replacement of oxen and milk production	
Sheep	Plain land dwellers	3rd , for cash income and reproduction	
Goats	Upland dwellers	3rd , for cash income and reproduction	
Poultry	Women farmer	1st , for immediate cash income and consumption	
Beehives	Men headed farmers	Additional cash income	
Donkeys	Men of medium and better-off households	Transportation service	
Mules	Better-off	Transportation service	
Horses	Better-off	Transportation service	
Camels	Better-off	Transportation service and wealth security	*Lenche Dima*

Table 6.19 Farmer preference ranking in *Kuhar Michael* (preference ranking exercise)

	Animal type			
Criteria (farmers)	**Cattle**	**Sheep**	**Goats**	**Chickens**
Feed requirement	4	3	2	1
Water need	3	4	2	1
Vulnerability to disease/predators	3	2	4	1
Vulnerability to theft/predators	4	2	1	3
Productivity (fast return)	3	1	2	4
Market demand	1	2	4	3
Importance to the households	1	2	3	4
Consumption preference	3	1	4	2

Note: *1=least preferred, and 4=most preferred; HH=Household; MH=Male Headed; FH=Female Headed*

The ranking reveals that keeping cattle is costly and yet highly beneficial. However, poor farmers can secure relatively high benefits by keeping chickens, bees and donkeys, which incur the least costs, but these animals are preferred least by the poor farmers. This calls for a change in attitude. From the feed and water requirement perspective, goats and chickens are preferred to cattle and sheep.

A study conducted by Descheemaeker et al. (2009: 8) also indicates that at farm level, livestock-water relationships vary depending on the composition of the animal herds, the production objectives of farmers, livestock management practices,

market links and livestock health and productivity. In the study areas, where draft power is an important animal output, farmers tend to provide high quantities of good quality feed for oxen. Hence, oxen are the major users of feed and water, and yield valuable outputs.

The findings indicate that LWP value at household level is a function of multiple factors. These include value or contribution of livestock keeping to livelihoods improvement and gender equity, associated gendered cost of input and intra- and inter-household distribution of the output, preference of households/individuals with respect to animal type and the respective objective of keeping those animals.

There are opportunities and threats at the study sites. The opportunities include the various efforts by governmental and non-governmental institutions (like credit and extension services) regarding livestock production and productivity improvement, interest of farmers in livestock keeping, and the availability of certain enabling assets. Despite these opportunities, the poor households cannot invest in LWP improvements. Apart from technological and environmental factors like drought and flood shocks, access to and ownership of basic resources, households' capability, and the initial and running cost of livestock keeping are some of the major disabling conditions. According to the findings, livestock ownership varies among households, especially by gender lines and wellbeing classes. The ownership of poor women-headed and young farmer households is limited to small animals without oxen or with one ox. This is due to limitations in accessing other assets like land, labor, finances, and to other socioeconomic factors that determine their capability and interest.

From the surveyed respondents, more than 25 % do not own livestock at all and 50 % have incomplete draft power mainly due to labor and finance constraints. These limitations make it difficult for mostly women-headed households to engage in LWP improvement. Limited access to feed sources (especially crop residue) coupled with financial constraints (due to low income and access to credit service) also affect the capability of poor young and women-headed households to benefit from livestock resources. Women and young farmers have a limited access to crop residues due to their small farmland size. The poor households that lack draft oxen and/or labor and using share-cropping arrangements also have a problem regarding access of crop residue (mostly women in *Lenche Dima*, where only grain yield is shared).

In general, the following disabling factors were identified in relation to implementing LWP improvement efforts in poor households:

1. lack of appropriate, cost-effective, and labor-saving technology to access water and feed;
2. improper targeting of participants in livestock and water development programs;
3. disintegration of diversified productive livelihood activities by households;
4. communities' low level of awareness of use of different assets and services;
5. risk adverse mentality in poor households; and
6. inability to cope with vulnerability issues, especially in the course of climate change.

Therefore, in light of the aforementioned disabling factors and by targeting the poor households lacking resources, the following interventions are forwarded as solution options.

1. Labor-saving strategies for provision of feed and water refer to keeping manageable herd sizes of productive animals and considering animal type preference. The strategy adopts zero/minimal grazing and stall-feeding practices and is integrated in measures like crop residue treatment, backyard fodder production, and nearby water availability.
2. Keeping animals that require little water and feed as well as low investment costs such as small ruminants and poultry for the very poor labor- and land-constrained households;
3. Seasonal arrangements for certain preferred enterprises with market integration. This refers to activities such as fattening of animals during times when labor, feed and land are readily available and with due consideration of market demand for strategic culling. For instance, it would be helpful for landless farmers in the water-stressed area of *Lenche Dima* credit services were facilitated so they could fatten camels by, since these can generate a good deal of income while adapting to the climate change impacts.
4. Empowering draft oxen constrained poor women and men farmers with financial support or other means to access draft power would help them to use their land by

themselves. In particular, women farmers, who have land and labor but no financial means, can be the mainly targeted.

5. Integrating some post harvest activities like processing and selling of livestock and livestock products and feed supply with other livelihood activities could contribute to improve the wellbeing of the poor and land constrained households, especially young farmers by forming appropriate groups.
6. There is also a need to enhance the credit delivery system through careful targeting, strong follow up, availing adequate amount, appropriate repayment schedule, and creating awareness about the service; and
7. Focusing at multifunctional and relatively valuable animals for resource poor men and women farmers and improving awareness, resource access, and technical support in general is significant (see Table 6.21).

The above options for livestock productivity improvement interventions are suggested based on livelihood problems related to livestock production activities. It is, however, important to underscore that these interventions are indirectly related to water productivity. For instance, the labor saving strategy will improve water productivity for targeted animals, since water can be accessed and used at low labor cost, the output of which benefits the poor. The target for water productivity improvement for a certain animal from the livelihoods perspective is all about minimizing monitory and non-monitory costs of the denominator and maximizing the monitory and non-monitory value of the numerator in the LWP equation (section 2.2.1). Camel fattening, for instance, contributes to water productivity in that a higher return is obtained and while only a low intake of feed and water is needed, and hence a high LWP value is produced. However, the result would be quite different if the camels were to be slaughtered, since the poor cannot afford to eat the meat. As a result, the water productivity for such camel would be very low, no matter how low the cost is. Therefore, it is difficult to establish linear relationships among water, livestock, gender, livelihoods and environment.

6.1.5 Socio-cultural and institutional consideration in targeting LWP programs

In this section, the different social, cultural, and institutional issues that are related to water and livestock management are discussed along with their collective impact on productivity and livelihoods improvement.

In order to implement the LWP improvement strategies and achieve the required livelihood outcomes, it is vital to identify and analyze the transforming structures (institutions, policy, and processes) and other socio-cultural issues. This is because local institutions and social assets were found to be significantly important to resolve local/micro-level problems and conflicts, especially in governing common pool resources like small surface water bodies (e.g., communal ponds (in *Lenche Dima*), irrigation systems and domestic water distribution) and pasture/grazing land in livestock keeping. Common pool resources often make a substantial contribution to the livelihoods of the rural poor, especially small and marginalized farmers, pastoralists and landless laborers (DFID 2002: 1-2).

Institutions and social assets[20], with their common elements of norms, networks and trust, are used as supportive structures for facilitation, coordination, and cooperation among individuals or households at local or community levels for effective implementation of interventions (World Bank 2000). Institutions include the social and political environment that enables norms to develop and shape social structure (Kollmair 2002 in van Koppen and Putnam 1995 in lecture note). These could be organizations and/or rules, which influence actions or determine decision makers, procedures, permit actions, information and payoffs of individuals (Ostrom 1990, 2005 in Descheemaeker et al. 2009: 20). And rules could be formal in legislation or informal in societal agreements – determined by history or culture (IFAD 2008); governed by behavioral norms in society, family, and community; including sanctions, taboos, traditions and codes of conduct (North 1990 in Descheemaeker et al. 2009: 20). *Keres, idir* and *mahiber* can be mentioned as examples of such informal institutions and rules.

[20] **Social assets** represent social resources or organizations of horizontal association in which people coordinate and take actions to achieve desired goals or livelihood outcomes. This includes networks and connectedness that increase people's trust and ability to cooperate, or membership in more formalized groups and their systems of rules, norms and sanctions embedded in the social structures of societies. Institutions and social assets both indicate the social structure, and they facilitate certain actions of actors within the structure (Coleman, 1988 in Lecture note 2007). They share important issues like norms, networks, and trust used for coordination and cooperation among individuals/ households, local communities, national, international issues on both private and public goods.

Social capital, which refers to connectedness for mutual benefits, directly affects other capitals by improving the efficiency of economic relations or by reducing the 'free rider' problems associated with public goods through the mutual trust and obligations it imposes on the community (De Haan 2001 in van Koppen 2006). Thus, investigating social capital will help to understand how farmers relate among themselves and with other actors in accessing resources and services from different sources. It also influences the rules of access to resources, the change of assets to valuable commodities, and the way people act to improve their livelihoods and mobilize and defend their assets. Moreover, it is important to understand the socio-cultural issues in general and identify cultures[21] that are related to the utilization of water and livestock resources in particular.

Interventions for institutional improvements are especially required for commonly owned natural resources management and environmental protection. Within the livestock production system, overgrazing, which causes land degradation and resource competition that results in water and land-use conflicts are critical issues that need strong institutional arrangements for effective implementation of LWP programs at community level (Benin et al. 2004). Collaboration in the use of scarce natural resources can avoid conflicts among different resource users (van Koppen 2006). Hence, strong institutions are fundamental to minimize and resolve these problems through promoting equity among various groups, disseminating information about policy and program objectives, and introducing improved resource management practices (Descheemaeker et al. 2009). As water and grazing land are institutionally important natural assets in livestock keeping, enabling institutions are necessary to provide support in different areas, such as community resource management, credit facilities, and value adding facilities (e.g., butter production), by taking the establishment of input-output markets into account. Moreover, as stated by Descheemaeker et al. (2009), institutions offer farmers a new way of insuring their

[21] **Culture** refers to knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving. It is a way of life of people; cultivated behavior through social learning based on traditional ideas and especially their attached values, and is symbolic communication. Cultures in general are determinant of informal rules and are governed or ruled by informal and formal institutions (DFID 2002).

assets or securing their savings, and they are important with respect to minimizing herd sizes and pressure on land and water resources.

In addition to institutional arrangements, socio-economic and gender aspects are the other concerns in common resources use and management in livestock production systems. Socio-economic elements and institutions play an important role in determining roles, responsibilities and benefits of keeping livestock. Social and cultural norms dictate the division of labor and control over assets. Policy and institutional structures often determine existing sources of support to the poor. For instance, in the study sites, it is difficult to access credit for acquiring cattle for the poor due to high investment costs and presumed risk. Values, norms and moral codes, which are embedded in culture and tradition, have a very strong influence on gender, as they shape attitudes and the organizational setup of the whole community system and thus, any change in these factors affects the implementation of gender-sensitive programs. Hence, local-level socio-economic setup and influential factors are essential in implementing interventions at micro/household level since social and cultural factors determine activities while economic factors are the basis for change in participation (Bravo 2000).

Based on the problems/gaps observed in the process of facilitating, coordinating and integrating livestock production activities and farmers' experience in coping with certain social and individual livelihood problems, this part of the study explored important local-level formal and informal institutions and socio-cultural assets. It focused on the informal local-level socio-cultural and institutional issues relevant to livestock water productivity from the gender and livelihoods perspective (social assets of SLF, the horizontal and within farmers' networks). This is because successful implementation of an intervention depends on social acceptance, appropriateness, and enabling environments like institutional and socio-cultural supports (IGAD, 2008). Besides, livestock production in the mixed system in the study sites largely depends on common pool resources like communal grazing lands and public water sources in which water governance, grazing management and livestock keeping practices need institutional arrangements at the local level for effective implementation of the LWP program.

Institutions and social assets in the study areas

In the study sites, various formal, informal and other social institutions were identified (Table 6.20).

Table 6.20 Institutions in the study sites

Study Site	Institutions			
	Formal			Informal
	Governmental	Nongovernmental /Bilateral/	Others	
Lenche-Dima water shed	- *Kebele* administration structures - Structures in the agricultural and rural development, health and education offices	- AMAREW, - SAVE the children, - UNICEF	- Water users association (WUA's) - (*Alawuha* irrigation cooperative) - Hill side development committee - Community development group - Farmers' cooperatives - Mosque	- *Kere,* - *Debo,* - *Mekenajo,* - *Yekul,* - *Wonfel* - Exchange - Marriage
Kuhar Michael Kebele	- *Kebele* administration structure - Structures in the agricultural and rural development, health and education offices	- FINNIDA - ILRI/IPMS/ - NLDP	- Water use committee, - *Guant-Lomider* Irrigation cooperative - Farmers' multi-purpose cooperative - Women cooperative - Church	- *Edir,* - *Debo,* - *Mekenajo* - *Yekul* - *Wonfel* - *Mahiber* - Exchange - Marriage

Source: Kebele DAs and Key informant interview

Formal institutions

The local-level formal institution is represented by the *kebele* administration (KA) or peasant association (PA), which is the lowest official unit of governmental organization. The *kebele* administration has its own sub-division responsible for land use and administration, other communal property administration with the community, facilitating and following up rural development activities such as the safety net program, rural credits, collective community work and resolving local conflicts. It is headed by a chairman and has different council members (vice chair, house speaker, agriculture and rural development, education, health, women affairs, youth and sport and security and military). The social court at the *kebele*, comprising four members, is a conflict-resolving institution that can impose fines up to Birr 300 or one month imprisonment. Women, youth and elders' associations also fall under the support of the

kebele administration. The *kebele* level rural development coordinating committee (RDCC), which is headed by the chairman of the *kebele*, undertakes different community development activities. Credit and saving institutions like ACSI, micro-enterprise, and farmers' cooperatives, input suppliers like farmers' cooperatives and other bilateral bodies like ambasel, irrigation cooperatives, etc., are also included in this formal institution.

Other institutions (include NGOs)

Currently, the following institutions operate in *Kuhar Michael*: IPMS, which focuses on interventions to improve crop and livestock production and marketing activities; Wetlands, a local NGO aims to improving wetland management; and FINNIDA, an international NGO that is engaged in water supply and sanitation development and management works. In *Lenche Dima*, ORDA, Save the Children UK, UNICEF, and AMAREW (USAID) support community development works, such as soil conservation activities, mainly through food for work and food aid programs; especially AMAREW (2003-2007) greatly contributed to developing and changing the watershed.

Informal institutions:

A considerable number of informal institutions were identified in the study sites that can positively contribute to LWP improvement. For instance, *Kere* in *Lenche Dima* or *Edir* in *Kuhar Michael* stands for community groups primarily established for mutual social benefits like facilitating funerals. But they are also involved in soil and water conservation activities, other community works, and information dissemination. Water user associations, community work committees, women groups, hill development committees and groups, and local money lenders also fall under this category. In *Lenche Dima*, *Keres* are informal institutions linked to Islam that are involved in the facilitation of wedding and funeral ceremonies and mobilization for prayers during stressful conditions like drought. Elected by the community, committee members in the *Keres* also coordinate and mobilize the community in weeding activities and construction and maintenance of communal ponds. Members of the community contribute in kind and cash as appropriate to cover related expenditures. However, they are not adequately

supported by the formal institutions at *Kebele* level and accordingly have less decision-making power (Mapedza, 2010).

Informal institutions as social assets

There are many informal institutions in the study sites that can be considered as social assets:

1. *Debo/Jigi* is a joint work group among several farmers for mutual assistance in agricultural activities, such as weeding, harvesting, and threshing. In such type of arrangement, the farmer who gets help is not obliged to pay it back;
2. *Mekenajo*/ox share is a practice by which two households combine their oxen to form a pair and plough their fields;
3. *Wonfel*/ joint is a labor arrangement between two or more households to handle their farm activities like weeding and harvesting. Unlike *Debo/Jigi*, in this arrangement every farmer has the obligation to pay services back.
4. *Mahiber* is a religious gathering of social group meetings once a month for a feast on a rotational basis. It is mainly used for conflict resolution and information dissemination.
5. *Sheh lega* and *abegar* refer to traditionally and socially respected religious leaders and elders in *Lenche Dima*, who have influential power and can mobilize communities for group work and conflict-resolving purposes (Descheemaeker (2008)).
6. Other institutions include resource-sharing networking like share cropping arrangement, building community trust (in *Lenche Dima,* for instance, crop residue is stored on the field unlike in *Kuhar Michael* where there is risk of theft), collective work arrangements, mutual help networking and kinship.

With these social assets, the farmers help each other in resolving social and individual problems like shortage of human and animal labor for agricultural and social activities, temporary financial constraints and other problems.

Institutional services include agricultural input supplies, credit provision and output distribution or market facilitation.

Input supply

Fertilizers, improved seeds and pesticides are supplied to farmers through the *woreda* agricultural office of and the cooperatives promotion office in *Kuhar Michael*. In *Lenche Dima*, supply of these inputs is very limited and is one of the major causes for low productivity. With respect to livestock production, additional feed and veterinary services are purchased from private farmers and drug shops, respectively, in both sites, and represent a significant portion of the overall household expenses.

Rural credit and saving

Credit institutions in the study sites mainly provide credit services and mobilize savings. Credit services are relatively better in *Lenche Dima* than in *Kuhar Michael* due to the availability of the Productive Safety Net Program (PSNP) and other governmental revolving funds, while the Amhara Credit and Saving Institution (ACSI) is the only one in *Kuhar Michael*. Those credit services are not adequate to meet the demand of the community (Deschmaeker 2008). Local money lenders, friends and relatives are the other important informal financial institutions, though they only provide small short-term loans for consumption purposes. Generally, in the study sites the sources and uses of credit widely vary, for instance, it is relatively easier to access credit for buying animals in *Lenche Dima* than in *Kuhar Michael*.

Problems requiring institutional arrangements

Problems were identified with respect to management of communal grazing areas including enclosures, irrigation water use, distribution and management, domestic water supply services, communal water-harvesting structure management, credit and extension services, and other collective works. They indirectly contribute to LWP through water and feed access but also to environmental degradation.

Grazing land management including enclosure

In managing grazing lands, the existence of free grazing and violation of grazing land use rules and limited enforcement are major problems. This is due to the poorly functioning committee, which does not have support from the formal *Kebele* administration. The impact on LWP is through water pollution, canal distraction,

problems regarding fodder and food production, and limited vegetation regeneration in the enclosure.

Free grazing on both protected communal grazing lands and farmland during off-season is a vital concern in both sites. This problem hinders farmers from growing multipurpose forage plants on and at the edge of farmland. Irrigated agriculture is also affected by livestock damage to the crops, water canals (especially the earthen) and by pollution of the water with dung. Farmers in *Lenche Dima,* for instance, have left the irrigable land fallow due to this free grazing problem. In the enclosures, free grazing is still being practiced although this is against the rules due to the loose control.

Irrigation water management

Generally, water theft, water-use conflicts between upstream and downstream farmers, limited participation of farmers in canal maintenance, especially those with little irrigable land, water structures and canal maintenance problems, particularly in *Kuhar Michael,* inactive irrigation water users association committee, and absence of separate livestock watering areas (troughs) are basic problems in the irrigation water management works.

Though irrigation water distribution rules are in place, some farmers use water in excess of their share during night time, especially in times of water scarcity. There is also a conflict between the upstream and the downstream irrigation water users, since many farmers in the upstream use water pumps; this is not allowed in the irrigation system as it reduces the water level for the downstream farmers (*Kuhar Michael*). When drinking water from canals, animals not only pollute the water but also cause damage to the structures. Due to such damage and the accumulation of sediments, the canals need constant yearly maintenance, and this requires the community's cooperation. However, the level of participation varies among members of the community for two main reasons. Firstly, the irrigation water user association cannot force the non-members to participate in the maintenance work since these had not participated in the formulation of the rules. Secondly, irrigable land is not distributed equally; those having small irrigable land are reluctant to participate. Land distribution is a policy issue where institutions should strengthen rule enforcement and link with the formal *Kebele* administration.

Domestic water distribution

Water distribution from the domestic water supply structures also needs arrangements for separate livestock watering and domestic water use. Structural maintenance in *Kuhar Michael* is limited due to the poorly performing committee. Valuing water is necessary to improve productivity per unit amount of water but vary from culture to culture. For example, farmers with home- connected pipe water in *Lenche Dima* sell water to generate income during shortage times, while water from private hand-dug shallow wells is freely shared by neighbors in *Kuhar Michael*, especially, for domestic use, which strengthen the social values. Water pricing and demand management for both domestic use and livestock watering in water shortage areas will encourage farmers to use water more effectively. Deficit irrigation is also suggested by Sisay (2009) for irrigation water.

Mobilization problems in community work

There are many problems in relation to mobilizing members of the community for collective works. For instance, in *Lenche Dima*, community work was mostly undertaken through food for work programs and payment is made only to those farmers under the productive safety net program (PSNP). This situation has made other farmers reluctant to cooperate in community works. Accordingly, community water-harvesting ponds, for instance, are not getting attention even from PSNP members due to the dependency syndrome of the PSNP food for work program. In most cases, community work is very limited in *Kuhar Michael* (Ali 2009), where *Kere* and *Edir* play more important role than the formal institution of *Kebele* administration in mobilizing the community for such activities.

Problems related to credit and extension facilities

These include problems in targeting and selecting the beneficiaries. Furthermore, young farmers are presumed to be defaulters. Absence of collateral/insurance like livestock, and short repayment schedules are also the other factors that prevent the poor farmers from accessing credit services. The situation in the extension services is not different; and the poor farmers have the same problem regarding participation in credit-supported extension program. Since 1999, credit participants have been selected by a committee

that comprises the *Kebele* administration and women representatives. Farmers in the community expressed their fear that the *Kebele* administration may use its influential power to select unsuitable targets.

As also described in Descheemaeker (2008), the other main constraints that limit households' access to credit are the high indebtedness of the debtors, the terms and conditions of the financial institutions (interest rate, loan size and term), the limited capacity to repay loans, the limited availability of loan guarantees and the inaccessibility of the institutions. The main reasons for loan defaults are the diversion of loan to consumption, natural hazards (drought, flood, etc), low production and productivity, and market related problems.

Land-use networking

There are instances where farmland share cropping agreements are breached, usually on the part of farmers who rent in, which deprives the right of the powerless women and poor farmers to decide on their own land-use system. However, sometimes the poor farmers themselves break the agreement seeking for better benefits, since there is stiff competition to rent in land, especially among land-less young farmers. Though the land administration committee at the *kebele* level is responsible for handling such unlawful acts, it is not actively executing its mandates due to the complicated nature of its land-use administration, and usually transfers the cases to the upper body, i.e., the *woreda* land-use administration. In such cases, women farmers suffer, since they have limited capability and power to resolve such cases. Alternatively, farmers use local traditional institutions like *edir* and *mahiber* in *Kuhar Michael*; respected elders like *abagar* and *sheh-lega* in *Lenche Dima*; and religious institutions, etc., to seek solutions rather than the formal legal process.

Another study in the same project also indicates that the implementation of development efforts through decentralization of formal institutions constrains poverty alleviation through the use of livestock and water in rural Ethiopia. At local level, farmers' organizations, women and youth groups, cooperatives, self-help groups, etc., are organizations that, through their day to day functioning, influence agricultural practices and land and water management. Water user associations (WUAs) are the most common local institutions engaged in water management at the level of the

landscape or hydrological units. These are social units commonly organized by communities themselves for their own benefits for fair water distribution, improved water delivery and accounting. In Ethiopia, the role of WUAs is commonly restricted to the distribution of water among members, rehabilitation and maintenance of secondary canals and addressing water-related conflicts. WUAs are sometimes threatened by equally established government-supported cooperatives, which have broader operational scopes and stronger links with government institutions (Descheemaeker 2008).

The role of institutions in livestock water productivity and livelihoods

Poor households like women and young poor farmer groups use informal institutions such as collective work (d*ebo/jigi*), shared/joint/exchange, or share-crop arrangements for basic agricultural activities like plowing, weeding, harvesting, and transporting harvests to temporarily solve problems. There is a need to integrate such institutions with the formal ones for effective implementation of interventions.

Others include safety net program and credit/loans from either formal or informal institutions (better-off households and local money lenders) either in the form of cash or in kind (grain) or from relatives. Kinship, especially close relatives help each other in sharing and exchanging animal and human labor and working jointly. Such type of arrangements minimizes forced land rent out. Though the poor farmers sometimes have access to free oxen labor during holidays, working in those days is strictly forbidden in *Kuhar Michael*. This is challenging on the part of the poor farmers since it leaves them in dilemma: should they choose to undertake agricultural activities (like sowing, which is time sensitive) and thus be socially condemned or should they retrain from working and thus remain socially accepted on the one hand but lose their income generating opportunity on the other.

Informal institutions better serve the community than the formal ones in solving problems at grass root level. They are important contributors to adopt, transfer, disseminate and facilitate interventions. For instance, self-help women groups in *Kuhar Michael* are not in a position to get any attention from cooperatives and associations but only from the *woreda* gender expert. There is no responsible organ that helps them to be well organized and productive. Due to this, they are only engaged in non-agricultural activities like cotton thread making for the market.

Role of culture in livestock water productivity and livelihoods

Culture has its own impact on productivity and livelihood improvement. Plowing culture and the associated value given to draft oxen, religious holidays on which major agricultural activities are restricted, religious restrictions in consuming animal products during fasting times, religious restrictions in sacrificing goats for religious festivities like Easter, Christmas and other fast breaking times, and cultural restrictions in using goat milk and camel products are some of the cultural factors related to LWP.

It was observed that rural communities have their own cultures, which can contribute to and influence their day-to-day livelihood activities. The culture of plowing and threshing has given high economical and social value to oxen, which makes draft oxen play a very crucial role in the improvement of agricultural productivity. In relation to this, institutions like joint, exchange, and collective work arrangements of oxen and labor by resource-poor households are used as coping mechanisms in agricultural activities. This demonstrates the interdependency relationship between culture and informal institutions, in which any change in one affects the other. If the oxen plow culture is changed or substituted by a certain technology or innovation in land cultivation, the value of oxen and the role of the associated social assets will be shifted. This in fact helps the poor to shift the expenditures related with draft oxen to other value-adding activities like keeping other animals (i.e., milking cows) for better benefits including food, income, job opportunities and asset growth. It would also help women and draft-power-constrained poor farmers to use their land themselves and improve their livelihoods. Besides, the role of the social assets (joint, exchange and collective work arrangements) and their structures may not be the same, as it used to be.

According to orthodox Christians, major agricultural activities like plowing, weeding, and harvesting are restricted during holidays (about 10 to 12 days in a month). However, the farmers can use the idle labor in those days for productive activities like livestock care for instance. This in turn enhances labor productivity on the one hand and helps farmers to remain in a good social position on the other. It is to be noted that those who do not celebrate the predetermined holidays will be exposed to financial fines from the *edir* (traditional and still powerful social institution), and exclusion in extreme cases. The disobedient farmer will be a social outcast and loose the social benefits and support.

As indicated above, religious rules also restrict the consumption of animal products during fasting days (about 240 to 250 days in a year). Accordingly, the market demand for items like chickens, cattle and sheep will be low, but the demand will rise during fast breaking times. This calls for the need to integrate the fluctuating market demand into livestock production schemes, e.g., fattening, and thus improve LWP and increase the income. For some perishable animal products such as butter and cheese, preservation technologies might also be needed.

In the study sites there is also a cultural and religious belief that restricts the consumption of products of camels and goats, which means goats are not sacrificed in religious festivities. Furthermore, in the Muslim society, female goats are also not used for sacrifice. This has its own adverse impact on the production of goats and camels for food security and their social value. By raising awareness creation, there is a possibility to optimally utilize such resources, at least by keeping these animals for markets outside the locality. Religious places and the leaders could contribute their part to initiating changes in such conflicts of culture and poverty. Undervaluing animals like donkeys, which are a low cost but important means of transport, is the other concern for LWP. Moreover, it should be underscored that donkeys provide social and economical benefits as they can be exchanged, borrowed or rented.

This study relates these informal institutions and social capital, governing processes and socio-cultural issues with the intention to encourage the institutions to influence the cultures and beliefs to enhance their contribution towards LWP improvement and poverty reduction. For instance, animal management through selecting animal species with relatively better LWP value is one of the LWP improvement strategies. In this connections the camels can best adapt to the present environmental situation in *Lenche Dima,* since the costs of feeding and protection against predators are low, which is presently the focus of attention of the local farmers. However, the culture associated with consumption of their products on one the hand and the beliefs of the adjacent neighboring Afar pastoralists who control female camel accessibility across community borders on the other hand affects their contribution towards poverty reduction. Moreover, it affects social security: when female camels cross the regional boarder (e.g., into the Amhara region), conflicts arise that may need higher-level institutional support for resolution.

In summary, the research findings reveal the following challenges with relation to questions of resource governance and management activities, which again will have a direct impact on any LWP improvement efforts of the future:

1. free grazing, rule violation and weak enforcement in area enclosures and irrigation schemes;
2. water-use conflicts between and within upstream and downstream communities, and weak collective action for irrigation canal maintenance;
3. destruction and degradation around irrigation canals and water distribution points due to absence of integrated livestock drinking water supply in both schemes;
4. weak cooperation of the community in pond management due to the "food for work dependency" problem in *Lenche Dima* (national 'Safety Net' program) and in communal natural resources management in *Kuhar Michael*; and
5. improper targeting, amount, repayment time, and interest rate for credit access; limited extension services for livestock productivity, and problems related to farmland sharecropping arrangements. These are partly due to weak performance of local formal and informal institutions and loose integration of one in the other for working harmoniously.

Under normal conditions, the *kebele* administrations in the study sites smoothly work together with informal institutions. But in some cases, they do not provide the necessary support for informal institutions, especially in livestock/water issues. For instance, the administration failed to resolve the conflict in closed communal grazing land use in *Kuhar Michael*. The informal institutions such as committees of irrigation water users, community work, hill development group, enclosed communal grazing area management, and women groups are all poorly performing and have loose relationships with formal *kebele* administrations as also mentioned by Tilaye (2009 draft paper of writing workshop held at IWMI).

However, others like *kere* (religion-based grouping) in *Lenche Dima*, and *Edir* (social-based grouping) and churches in *Kuhar Michael* are strong institutions greatly contributing to mobilize community work and conflict resolution in collaboration with the formal *kebele* administration, apart from their religious and social roles. Social assets such as collective work arrangements and traditional irrigation water management

using water fathers[22] play a remarkable role in solving basic livelihoods problems. All local institutions mentioned above contribute positively to LWP and livelihoods improvement. But exceptionally in *Lenche Dima*, the sharecropping arrangement contributes less to the land owners who share-out land to keep livestock as, the whole crop residue output is going to the other farmer who contribute labor and draft power. Therefore, it is of paramount importance to consider all these factors in targeting and implementing LWP improvement interventions to achieve the intended objectives.

Gender participation in the communal and local institutions

The findings with respect to gender-specific participation in institutional regulations and settings show that most members in formal institutions are men. In *Kuhar Michael,* for instance, the number of men in the *kebele* council is fivefold in that of women participants. The same is true in youth associations at *kebele* level. Irrigation water use association committees completely exclude women in both study sites. In the water committee for domestic water supply, two out of five members are women. In contrast, the participation of women farmers is relatively better in farmers' cooperatives and informal women groups. Mostly, these women are from women-headed households. Women in men-headed households are not socially encouraged to participate in such productive activities. Since they are relatively respected and have a leading role in coordinating and facilitating social activities, they are to be considered as power factor in social institutions.

Moreover gendered networks can be established using livestock resources through sharing of labor, oxen and donkeys (Adamo, 2001 in van Heeve and van Koppen 2006: 18). However, widows and divorcees do not freely involve in such arrangements due to cultural barriers. Thus, it is important to empower women in coping with such challenges so that they can make use of their own land rather than renting it out or sharing it.

[22] Water father here stands for a leader of a water point committee that is locally established to manage and protect water sources in the study areas. Water fathers work together with water committee members and keres and decide on fines for violators.

6.2 Further analysis and interpretation of the findings

The findings are analyzed and discussed under three subsections. Livestock water productivity is dealt with from policy, development and household livelihood improvement perspectives. In this section the importance of the livestock sector in poverty reduction, gender equity, as well as environmental wellbeing in the mixed crop-livestock system of production at different levels is presented.

6.2.1 Livestock and water in the government policy and implementation process

According to Benin et al. (2002), the national development strategy is mainly concentrated on Agricultural Development-Led Industrialization (ADLI) along with the national policy reform on land re-distribution, intended to include livestock development. The strategy is aimed at improvements in the livestock sector by enhancing the quality and quantity of feed, improving extension services, increasing livestock health services and improving productivity of local cows by artificial insemination while preserving the indigenous breeds.

In the market-oriented economy policy, among the different livestock production targets, dairy development was launched recognizing the potential of smallholder dairy production and giving due attention to smallholder producers. Activities undertaken include utilization of the potential adaptive genetic merit of animals, raising the quantity of the feed available to livestock, improving health services, breeding and husbandry services, encouraging the participation of private investors by improving income tax conditions, improving the delivery of artificial insemination, developing and expanding efficient marketing systems in remote areas, and organizing farmers in milk producing, processing and marketing cooperatives (Mohamed et al. 2004: 17-18).

Poultry and bee production were also the focus of household-income improvement strategies by agricultural extension development works through providing improved breeds and beehives and improving extension and health services. Despite all these efforts, the dairy business tends to be limited to the peri-urban and urban areas on the one hand, and the outcome from the different endeavors is not as effective as expected due to various technical and implementation processes on the other hand.

The government livestock water supply policy also recognized that livestock water supply is an integral part of the overall water sector, and incorporates its development plans with comprehensive water resource management undertakings. It also promotes the availability of water through providing livestock water supply to all the regions with greater emphasis on water scarce and drought prone areas (MoWR 2001). In spite of this, the major sources of livestock drinking water in the study sites are still only natural sources such as rivers, springs, ponds and groundwater. Due to increasing drought and erratic rainfall incidences in the course of climate change, especially in *Lenche Dima* drinking water for animals has become scarce. As a result, livestock become stressed, especially during the long dry months, when temporary livestock migration is practiced as an alternative means of getting water. This in turn, however, has negative impacts on the animals' performance; for instance in *Kuhar Michael,* it causes genetic dilution of the endogenous cattle breeds and transmission of diseases from one area to another, and thus needs policy attention.

According to Halderman (2004), livestock are viewed by decision makers primarily in terms of their contribution to crop production (as draft animals), which prevents appropriate recognition of the value of livestock to the livelihoods of the poor and the potential of livestock for poverty reduction. In addition, livestock production is little integrated into the design and implementation of many irrigation schemes as observed in the study sites, which has resulted in limiting the benefits in the livestock sector through the irrigation schemes, and has undermined livestock husbandry in different ways through reducing grazing areas because of river diversion or due to increased demand for water. Thus, investments in water and livestock have often failed to achieve maximum and sustainable returns because of a lack of integration of the two (Girma and Misra in http://www.iwmi.cgiar.org).

As argued by Earthscan (2007) integrating livestock with water management will help to bring about immense benefits that could not be achieved by either sector alone, enabling the poor livestock keepers to get more from their animals, while using less water and reducing degradation of land and water resources. Therefore, it is important to note that integration of livestock drinking water with agricultural and domestic water development efforts is vital.

6.2.2 Livestock and water in the development interventions

Livestock has been little considered in national development interventions, especially in water development works (section 6.1). Moreover, it is separately treated in the livestock production department of the agricultural extension program. As discussed earlier, livestock should be considered in both agricultural and domestic water development works. In irrigation development, it is very important to consider livestock drinking water, feed production, and management close to and around irrigation infrastructures. It is also important to analyze the management of water from the irrigation structures and groundwater sources where livestock graze or drink water in large numbers. In domestic water development, integrating at least livestock watering is essential, but there is a need to duly consider the quantity of water available to ensure sustainability.

In soil and water conservation work and livestock management, coordination and integration is still very limited. This is because livestock might cause damage to the respective structures due to open grazing, even though dual-purpose trees and grasses are sometimes used for conservation purposes. Thus protection and enclosures are necessary, especially in sensitive areas like sloppy lands, gullies and eroded lands close to waterways.

6.2.3 Household response to investments in livestock and water development interventions

Generally speaking, investing in livestock water productivity improvement can lead to a positive impact on poverty reduction, and improve livelihoods and gender equity. However, it is essential to identify, characterize and target appropriate participants and interventions accordingly. Moreover, one has to make sure that the enabling environmental, socio-cultural, and institutional conditions are in place.

While characterizing the different sub categories of the poor farmers, food insecurity was found to be the common feature. The factors that cause poverty and the specific level of wellbeing vary with relation to the target groups. These differences are mainly associated with the lack or shortage of basic assets. But the access to assets on the household level is only one decisive factor. Just as decisive is the institutional setting, i.e., the “Transforming Structures” according to the sustainable livelihood

framework (see Chapter 2). Households and household heads have limited access to essential services and to other enabling environments. Though there are overlaps in the research variables, some are explicitly linked to specific groups such as labor for women farmers, land for young farmers, and animal feed and access to crop residues for share croppers. As a result, the required interventions vary depending on their problems, livelihood objectives, priorities, needs and capabilities. Furthermore, it is important to take into account the common elements among the groups of individuals (Table 6.21).

Vulnerability and poverty contexts are always multifold and related to interlinked causalities, and thus a cause-effect analysis and intervention cannot be limited to water and livestock management aspects alone. Furthermore, the sites in general and the target groups in particular focused on by the research conception vary by virtue of the degree of vulnerability to different external shocks and their capability and coping mechanism in relation to stresses. Accordingly, the intervention options for the different groups are also different.

It can be observed that the first priority of all groups is securing food through improving agricultural production and income. This can be possibly achieved by facilitating and filling resource gaps by financial support for acquiring draft power and other livestock. Specifically, the foremost priority of most capable poor farmers is acquiring livestock, followed by finance and labor. Hence, meeting these needs through appropriate credit services is of paramount importance. Equally important are strengthening the local institutions/social assets and applying proper capacity building strategies are the other concerns. The other needs of these groups are appropriate technologies, technical support and other income generating activities. Livestock production, if supported by the necessary inputs, is best way to address most of their livelihood problems and improve their wellbeing status. Nonetheless, the most appropriate strategy for the very poor is facilitating the access to aid and other income sources, other than acquiring animals, since food security is the major priority.

As stated in Thornton et al., (2002: 434-435), in mixed farming systems like in Ethiopian highlands in general, cattle as draft animal allow households to plow and cultivate more land and alleviate labor bottlenecks during weeding. Hence it is still the most preferred livestock. Yet access to cattle, especially draft oxen, remains the key problem for the poor farmers in the study sites that need attention in poverty reduction

interventions. Moreover, most resource-poor households use dung as the only source of nutrients for improving soil fertility, crop production, and hence food production, since they cannot afford chemical fertilizers. In this connection the contribution of cattle is vital in providing dung, which has a dual purpose, i.e., fertilizer and fuel. Thus the poor can minimize expenditures. However, cost-benefit analyses are necessary when targeting livelihoods improvement.

Table 6.21 Target groups, poverty characteristics, priority needs and responsive interventions in *Lenche Dima* (LD) and *Kuhar Michael* (KM)

Typology of poor farmers	Livelihood characteristics target groups Poverty characteristics and causes	Coping mechanisms	Priority needs	Responsive intervention options
1 Poor capable farmers				
1.1. Women-headed, labor constrained households	- Food insecurity, i.e., poor nutrition quality and less quantity, labor burdened, low income, high factors impact on health - Limited property rights and weak capacity to use rights, e.g., land rights of both farm and grazing lands - Limited participation in agricultural and other productive activities due to labor and finance constraints - Weakness in social interactions, leadership capacity and decision-making power in public and accordingly poor social assets - Low income and lack of access to financial services - Lack of draft power and other animals, only chicken - Limited access to communal grazing land - Consequently vulnerable to shocks	- Sale of expensive grains (teff/rice), purchase of cheap grain (millet/sorghum) to fill grain gap - Borrowing grains or money from better-off individuals with 100 % interest rate (KM), 0 % (LD) - Renting out the land, mostly their entire area - Sending out the children (both male and female) for labor work (sale of child labor) - Selling firewood and dung cakes - Production and sale of local alcohol (KM) - Production and sale of cotton thread (mostly in KM) - Engaging in petty trade - Selling crop residues (from their share in KM) and grass (from enclosure in LD)	- Improved agricultural productivity on own land - Improved income for food security - Finance to buy or rent labor, draft oxen, and/or other livestock - Finance for non-agricultural income generating activities	- Improving access to livestock (manageable size and type) - Securing land rights - Improving credit services (adequate target and repayment schedules) for labor rent, rent/buy draft power and purchase of small livestock - Introducing labor saving technologies like private water source structures for multiple purposes including livestock watering and backyard fodder production - Facilitating other income generating activities like local trade; processing and marketing of animal products by cooperative groups (institution building), connecting to and empowering of a) informal institutions, e.g., cotton thread making group(*equb*) in KM, and b) formal, e.g., women's league

Table 6.21 continued

Typology of poor farmers	Livelihood characteristics target groups Poverty characteristics and causes	Coping mechanisms	Priority needs	Responsive intervention options
1.2. Women, with access to labor (support from children or other sources) and other assets	- Food insecurity, poor nutrition quality and quantity, high labor burdened, low income, all factors impact health - Limited property rights and weak power to ensure land rights - Limited participation in agricultural and other productive activities due to financial constraints - Weak capacity in social interaction, leadership capacity and decision-making power in public - Low income and limited access to credit services - No or incomplete draft power, and few small animals - Limited benefit from communal grazing land - Increasing vulnerability due to more frequent droughts and subsequent diseases - Livestock susceptible to diseases due to poor health status	- Selling expensive grains (teff/rice) and buying cheap grains (millet/sorghum) to fill food gap - Borrowing grains or money from better-off individuals with 100 % interest rate (KM) and 0 % (LD) - Renting out part of their farm land - Engaged in back yard agriculture like gardening - Keeping livestock (to some extent): milking cows, sheep or goats and chickens - Engaged in petty trade (to some extent) - In extreme cases selling child labor	- Securing food gap through improved agricultural productivity from their land; need draft power - Improving income to fill food and other basic gaps - Financial support to buy oxen, and / or other livestock - Build-up of own water source structure	- Improving access to livestock (draft power, milking cows and small ruminants) for productive activities, job opportunities and income; land access rights to grazing land and feed - Filling financial gap through improved credit services (better target and repayment schedule) to acquire draft power and small animals and construct water structures - Introducing labor-saving technologies like private water sources for multiple purposes including livestock watering and backyard fodder production

Table 6.21 continued

Typology of poor farmers	Livelihood characteristics target groups Poverty characteristics and causes	Coping mechanisms	Priority needs	Responsive intervention options
1.3 Men, poor farmers	- Food insecurity, poor nutrition quality and quantity, poor health - Limited capacity to use grazing land rights due to limited livestock resulting in limited benefits from communal grazing rights - Limited participation in social and productive organizations and extension packages due to input constraints, - Low productivity of agricultural activities due to input and financial limitations, - Low income and limited access to credit services, - No or incomplete draft power and few small animals, - Increased vulnerability in the course of climate change related recurrent droughts and subsequent disease shocks, - High susceptibility of livestock to diseases due to feed and water constraints	- Sale of expensive grains (teff/rice) and purchase of cheap grains (millet/sorghum) to fill food gap - Borrowing of grains or money from better-off individuals with 100 % interest rate (KM), 0 % (LD) - Engaged in share cropping, joint, or collective work - Gardening and keeping livestock like milking cows, sheep/goats and chickens - Engaged petty trade, handicraft or casual labor	- Food security by improved agricultural productivity from their own land; need of draft power - Improving income to fill food and other basic gaps - Financial support to buy oxen and/or other animals - Build up of own water source	- Improving access to livestock (draft power, milking cows, small animals) - Filling financial gaps through improved credit services (better target and repayment schedule) to acquire draft power and small animals - Improving availability of nearby or private water sources for multiple purposes including livestock watering and backyard fodder production - Introducing feed improvement technologies like crop residue treatment, fodder production and feed conservation - Promoting animal fattening for the market
2. ***Young poor farmers***				
2.1 Women without or with only very little land	- Food insecurity, poor nutrition, vulnerable to disease - Limited skill and assets to engage in livestock enterprises - Remaining dependent with family or relatives including farming activities - Lack of social stability and exposure to the challenge of migration (prostitution, high exposure to HIV/AIDS)	- Marriage - Migration to towns - Sale of firewood and locally made alcohol - Engaged in petty trade (to some extent)	- Food security - Improved income - Initial capital	- Encouraging the production of small animals (like small ruminants and poultry) that require low initial capital, feed and space and have quick returns, - Awareness creation programs and capacity building, - Facilitating other income generating activities like local trade, processing and marketing of animal products through formal and informal institutions.

Table 6.21 continued

Typology of poor farmers	Livelihood characteristics target groups Poverty characteristics and causes	Coping mechanisms	Priority needs	Responsive intervention options
2.2 Men without or with only very little land	- Food insecurity, poor nutrition and susceptibility to diseases - Limited skill and assets to engage in livestock keeping activities - Enforced discontinuation of farming activities due to shortage of draft power and finance, too small land sizes as compared to the labor potential and energy they have - Limited access to land for rent due to high competition and lack of finance for pay down payments - Poor credit rating by credit institutions and individuals - Lack of social stability; (migration, criminals like theft, and high exposure to HIV/AIDS)	- Work on family farmland or as hired laborer - Migration to other areas in search for work and other income sources - Engaged in trade and other non-agricultural activities like carpentry, construction work, etc.	- Financial support in order to buy draft power; rent in land and animals (goats or sheep) and other farm inputs (such as fertilizer) - Improvement of productivity of labor and land	- Encouraging production of small animals (small ruminants and poultry) that require low initial capital, feed and space and have quick returns - Awareness creation programs and capacity building, - Facilitating other income generating activities like local trade, processing and marketing of animal products through formal and informal institutions
3. The very poor farmers				
3.1 Capable but landless	- Food insecurity, poor nutrition and susceptibility to diseases, - Limited property rights and weak capacity to use their rights, esp. land rights due to absence of or limited livestock and land, - Limited participation in agricultural and other productive activities due to lack of land and other problems, - Weakness in social interaction, leadership capacity and decision-making power in public - Low income and limited access to credits,	- Consumption of cheap food - Borrowing of food grains or money from relatives and in extreme cases from better off households with 100 % interest rate (KM), 0 % (LD) - Engaged as wage laborer - Engaged in petty trade - Collection and sale of firewood - In extreme cases: child labor (own children)	- Food security by improving income mostly from non-agricultural as well as agricultural activities. - Financial support to rent in land or to buy livestock for productive activities	- Improving access to livestock (small animals) might help them to become engaged in productive activities, which creates job opportunities and improve income for the household; they can also use their access right to grazing land and feed - Filling financial gap through improved credit services (better target and repayment schedule) to acquire small animals - Facilitating land access through organizing groups (could be on

Table 6.21 continued

Typology of poor farmers	Livelihood characteristics target groups Poverty characteristics and causes	Coping mechanisms	Priority needs	Responsive intervention options
	- No or few smaller livestock, - Increasing vulnerability to climate change induced environmental changes - Frequent migration as not properly settled		- Land assignments from the government	communal land) for post-harvest activities like marketing animals or livestock production or fattening
3.2 Old-aged and incapable of working	- High food insecurity, poor nutrition and poor health, - Incapable of working, even if they have access to land - Dependence on food aid, relatives, social security networks, - No or very little land - High vulnerability to environmental changes and subsequent diseases - Lack of oxen and other livestock - Poor housing and sanitation - Lack of savings, remittances, or access to credits, - Weak social network bondages and no membership in reciprocal groupings.	- Renting out/sharing of land - Use of shared labor and free labor from relatives and the community - Revenues from begging	- Food security - Health care	- Facilitating food aid or other means to fill food gap - Providing health and social extension services

7 SUMMARY AND CONCLUSIONS

The major livelihood problems of farmers, especially those related to water and livestock productivity in gendered poverty reduction and their implications for interventions, exist on two levels, i.e., the community and household level. Site-specific problems are also discussed in order to determine regional differences and the appropriate type of intervention.

Community level livelihood problems and intervention implications in *Kuhar Michael* include firstly, flooding in the plain lands and soil erosion in the uplands. These have intervention implications for flood management and risk minimization measures, seasonal closure of pasture land and controlled feeding system, and water and soil conservation work. In relation to this, as the willingness to participate in community work in natural resource conservation is low, and informal institutions are poorly performing, community mobilization, awareness creation, and strengthening and empowering of informal institutions are also required for effective implementation. Secondly, livestock diseases, mainly trypanosomyasis (due to tsetse fly) and parasites accompanied with poor veterinary services and distant clinics, low technical awareness and proximity problems in relation to AI services, and side effects of pesticide sprays with respect to bee-keeping are the other problems. Mechanisms are needed for protection against and eradication of the tsetse fly, provision of veterinary services at nearby distance, strengthening of health and extension services, awareness creation and training, and facilitation of integrated pest management schemes. The farmers are also vulnerable to malaria and other water-borne diseases during flooding, which is another concern. Thirdly, unprotected hand-dug pits in communal grazing lands that are a risk to the life of humans and livestock, collapse of hand-dug shallow wells and pits, and less availability of quality drinking water (during the rainy season) and scarcity of water (during the dry season), and poor water structures maintenance are other water-related problems in both domestic water use and livestock watering. Thus, there is a need to strategically place and protect water structures for communal use, to introduce better technologies to stabilize hand-dug shallow wells and to increase reliability, drinking water development, and maintenance of existing structures. Fourthly, religious (orthodox Christian) and cultural restrictions, e.g., restrictions regarding working on holy days, consumption of animal products during fasting periods, consumption of goat

meat for religious festivities, and consumption of goat milk are other problems. These require mechanisms by which farmers can utilize their idle labor for productive purposes during holy days, and market integration and promotion of attitudinal change.

At household level, shortage of labor, especially in women-headed and old-aged poor households, land for women-headed and poor young farmer households, and draft power for about 50 % of households, are the main problems. In addition, conflicts due to breaking of land renting agreements by renters and the incapability to resolve such cases at the local level (women are more vulnerable), limited feed access for share croppers, limited fodder production technologies (especially lack of appropriate forage types) and limited credit services for the poor women and young farmers are the other constraints. This implies that introducing labor-saving technologies, providing financial and technical support, providing protected nearby water sources, introducing innovative technologies to make hand-dug shallow wells stable and reliable, strengthening formal and informal institutions so farmers can solve local problems by themselves, introducing environmentally-friendly technology packages (e.g., adaptable forages), and improving credit services (amount, repayment schedule and insurance) are necessary to benefit the livestock sector through water management and development efforts.

In *Lenche Dima*, recurrent drought in the course of climate change and the related awareness problems (tendency to relate the causes with religious beliefs causing fatalism), food insecurity, migration of poor, especially young farmers due to limited access to farmland and limited livelihood diversification, resource degradation and feed and water shortage, limited technologies related to crop livestock improvement and fodder production (e.g., appropriate breeds and management, adaptive forage varieties), and limited participation in natural resource conservation and development activities (due to dependency on “Food for Work” schemes, e.g., safety net program) are all community level problems. Farmer households have also limitations in livestock holding, especially draft oxen, and access to extension and credit services.

Thus, creating attitudinal change through awareness creation programs, introducing appropriate technology packages that can benefit men and women (e.g., water conservation, irrigation and drought-resistant/adaptable crops and animals, and environmentally-friendly forage trees and seed), natural resource management and poverty alleviation measures, and strengthening local institutions for mobilizing the community for developmental activities are required.

More specifically, introducing labor-saving technologies (such as nearby water sources, e.g., water harvesting), introducing/facilitating diversified livelihood activities and income sources (especially for landless poor), targeting and empowering poor men and women and young farmers through improving credit services (e.g., for draft oxen, small animals, other non-farm inputs) to engage in livestock production and/or non-agricultural income-generating activities are required at household level to solve labor, land and other resource access problems and hence improve livelihoods.

Summarizing, it is clear that vulnerability contexts like drought and flood shocks, which result in feed and water shortage, are the major environmental challenges for both men and women with respect to investments in livestock productivity improvement programs. Thus, environmental management with poverty alleviation and risk minimization measures is required at community level. On the other hand, limited access to resources (land, livestock and labor) and access to credit and other services are key factors at household level in relation to LWP improvement, especially for women and young farmers. Thus, it is vital to target the resource-poor households, especially women farmers, and to introduce labor-saving and other technology packages with improved services.

The other livestock water productivity constraints to poverty reduction encompass structures and processes such as improper targeting of participants in livestock and water development programs, limited integration of different productive livelihood activities in households, limited awareness in accessing different assets and services, and household capability, interest, preferences, and vulnerability to risks. Women-headed households, among other poor household groups, face most of these problems due to social and economical insecurity.

In this connection, targeting multifunctional and relatively valuable livestock varieties for resource-poor men and women farmers, improving awareness, resource access (especially livestock and related inputs) and technical support for diversified livestock water-related livelihood activities would greatly benefit the poor. Furthermore, providing poor and resource-constrained women and men farmers with financial or other supports, improving credit and health/veterinary services with the possible material and technical capacity-building strategies, and improving the institutional networks at local and communal levels are the other important considerations. It is to be

noted that the selected interventions will in turn dictate the livelihood activities of the households. Besides, households use material inputs, social networks and other assets in different combinations. The collective efforts of all these interventions would directly or indirectly contribute to water productivity improvement and thus gendered livelihoods through the iterative process of the gendered sustainable livelihoods framework loop.

On the other hand, improving water-use efficiency, especially in relation to livestock productivity and domestic use is vital, since water is an essential input for crop and livestock production in the mixed crop-livestock system where the livestock component is an integral part and basic asset of rural livelihoods, while water scarcity due to mismanagement increases rural poverty. Hence, targeted intervention is required to address the problem of rural poverty through improving water availability and productivity integrated with livestock management, since this would have positive economic, social and environmental impacts.

In this connection, the use of the MUS approach like “domestic plus” on the domestic water structures and “irrigation plus” in the small-scale irrigation schemes at community and household level is vital for effective implementation of water development interventions. Moreover, targeting poor women- and men-headed households will contribute to addressing poverty in the study sites possibly through providing a sustainable clean water supply for different productive and domestic activities, promoting multiple use of water from single sources to improve water-use efficiency, improving livelihoods through diversified productive activities and income, improving health through provision of clean water and by combating water-borne diseases, internal parasites and biting flies, and through saving time and energy for women, men, and children, and through improving their participation in social, community and educational issues.

Generally, the integrated effort of the government, community, and social institutions is of great importance to make the interventions operational through strengthening, empowering and capacity building processes. And thus far, it can be said that the gendered sustainable livelihood approach implemented in this study made it possible to assess the enabling and disabling conditions for investing in LWP improvement and thus livelihoods both at household and community-levels.

8 RECOMMENDATION

As expounded in different parts of this thesis, livestock production would undoubtedly contribute to achieve at least three Millennium Development Goals (MDGs) through improving the livelihoods of the rural poor. Accordingly, it can contribute to MDG 1(Eradicate extreme poverty and hunger) through provision of food and income for rural households; MDG 3 (Promote gender equality and empower women) through providing low-cost investment opportunities for both men and women poor to diversify income, improve livelihoods and reduce vulnerability to external shocks; and lastly MDG 7 (Ensure environmental sustainability) through better and integrated management of natural resources. Well designed, integrated and targeted livestock management/ development work can also contribute to mitigation of and adaptation to climate change impacts, and hence reduce greenhouse gas emissions.

1. In a bid to effectively implement LWP and bring about improvement in livelihoods, gender equity and environmental wellbeing, the interventions:
   - need to be well targeted with due consideration of site, social structure, gender, and cultural settings and differences;
   - should take into account households' and individuals' capabilities, interests and preferences, and vulnerability towards external influences;
   - need to be supplemented with empowerment, capacity building, and institutional strengthening activities;
   - have to consider the priorities of different levels: community, household and individual, though difficult to address each and every problem, and
   - more specifically, the different categories of poor farmers and their requirements need to be well analyzed while designing and implementing interventions in LWP improvement programs.
2. The costs from gender and livelihood perspective and non-monetary benefits need to be considered in the LWP value determination using the framework.
3. In order to make the framework better to design efficient LWP interventions, further analysis and modeling of efficient combination of asset (levels and values) for the different animal types and target groups might also be required.

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10 APPENDICES

Table 10.1 Principles of the sustainable livelihoods approach

1	People centered	Focus on perspectives, priorities and strengths of people – especially poor and vulnerable women/girls and men/boys. - Ensure that the needs and priorities of the poor are central and primary. - Take into account differences among 'the poor', including those that are based on sex, age and ethnicity. - Involve stakeholders from different organizations, government, NGOs and communities, to ensure that poor people's livelihood perspectives are represented.
2	Holistic	Recognize that different factors and processes influence the livelihood opportunities and choices of people and that people have multiple livelihood strategies in pursuit of multiple livelihood outcomes. - Look beyond single sector development programmes and projects. - Involve agency staff and development partners from different disciplines, as well as primary stakeholders, to broaden the range of perspectives. - Make linkages between different development program and project plans.
3	Dynamic	Recognize that poor people's livelihood strategies can change rapidly. - Be aware that livelihoods change over time (seasonal and longer term). - Adopt a process approach, with effective feedback and monitoring procedures. - Accept that the development program and project environment is likely to change over time. - Establish a process for reviewing and re-negotiating program and project objectives and processes at stages during the life-span of the intervention.
4	Building on Strengths	Start with an analysis of strengths rather than needs. - Do not analyze and plan around problems only, but also focus on strengths. - Use strengths, including good relationships, as a starting point for planning and build upon them.
5	Macro-Micro Linkages	Consider the linkages between the two levels to inform more supportive policies and institutions. - Recognize the impact of policy and institutional context on livelihoods. - Make links between micro reality and macro level influences. - Involve stakeholders from a range of levels (macro, meso and micro), giving equal voice to all.
6	Sustainability	Include analysis of environmental, social, economic and institutional sustainability. - Ensure activities are sustainable in long term (including economic, environmental, social and institutional sustainability). - Keep exit strategies in mind, and ensure transfer of skills and responsibilities.

Source: Tabulated from NAZID sustainable livelihoods approach guideline (2006)

Table 10.2 Examples of strategies for improving livestock water productivity

No	Strategies and activities
1	**Drinking water**
1.1	Provide sufficient quality water for optimal feed conversion efficiency and maximum growth and milk production - Reduce walking distance to water source or deliver water to animals. - Combine with zero-grazing strategies
1.2	Integrate livestock watering infrastructure to water development for domestic and irrigation needs
1.3	Develop drinking water sources to allow utilization of previously unused rangelands - Constrain herd sizes and animal movements so that land and vegetation adjacent to watering point is not unduly degraded - Separate livestock watering from water source used by people for domestic consumption - Keep livestock out of water reservoirs to prevent erosion, sedimentation, and spread of water-borne diseases involving livestock
2	**Feeding sourcing**
2.1	Integration within cropping systems, utilization of residues for feed, manure inputs
2.2	Utilization of food feed crops instead of sole purpose forage crops
2.3	Use irrigation infrastructure for feed production particularly if animal power is needed for cultivation
2.4	Import feed if water (virtual water) is scarce or highly valued
3	**Rain fed livestock production in rangeland areas**
3.1	Encourage collective action to reduced stocking rates. - Keep animal numbers at or below carrying capacity - Increase water productivity per animal - Establish policy and encourage livelihoods linked to reallocation of transpired water to restore agro ecosystems diversity, stability, and resilience - Encourage socially acceptable and guaranteed alternate wealth savings - Encourage collective strategies for reducing drought risk
3.2	Balance mobility of use of grazing resources with supply of drinking water
4	**Soil and ground water conservation in mixed crop livestock systems**
4.1	Encourage conservation tillage including restriction of animal feeding on residues to maintain adequate ground cover and to reduce the number of oxen needed.
4.2	Encourage zero grazing
4.3	Promote terracing to increase food-feed crop production

Source: Sonder et al. (2004: p. 22)

Table 10.3 Water supply system in Ethiopia

No	Basic types of water schemes	Descriptions and examples
1	Hand-dug wells with hand pumps	These are very basic systems that usually support a single water point. A typical site serves about 500 people. The wells are shallow.
2	Bore holes with hand pumps	These systems require the use of a drilling rig to reach ground water sources too deep for a hand-dug well. A typical site serves about 500 people. These are also single-point systems.
3	Bore holes with motorized pumps	These systems employ a motor-driven pump and can serve 1,000 to 5,000 people. UNICEF often provides financial support for the fuel required to run the pump. More than one service point is possible with these schemes.
4	Protected and developed springs	Employed where reliable ground-water springs are available, these simple projects usually serve about 500 people. However, Africa's longest developed-spring system (125 km) serves 22 villages with extensions off the main conduit. Each village has more than 1,000 users, making this system in southeastern Ethiopia a vital lifeline.
5	River intake and filtration	Few of these relatively expensive systems exist in rural Ethiopia, although there are some. One prime example is the system at Gode, in the Somali Region. Originally constructed more than 15 years ago, it was completely overhauled in the mid-1990s with funds and technical assistance from UNICEF. Powerful new pumps were housed in a new, flood-protected concrete silo, and a simple filtration system was added. The source for this system - the powerful Wabi Shebelle River - is a year-round water course that paradoxically passes through the driest part of the country. Unfortunately, its deep waters are too muddy for casual use and must be filtered.
6	Rain water collection Reservoirs	Used primarily in the dry, pastoral areas of eastern and southeastern Ethiopia, these systems are meant mainly to serve livestock. They are, of course, reliant on rainfall for replenishment.

Source: http://www.unicef.org/drought/water.htm

Note: 1) Working closely with the Ethiopian government, UNICEF provides funds and technical assistance for the development of water delivery systems at the local level. Most of the projects that UNICEF supports are in rural villages and towns where rainfall is unreliable and infrastructure is limited.

*With the exception of the Somali Region, much of Ethiopia is rich in ground water, even during the dry seasons. That makes long-term development the key to the country's water stability and self-sufficiency -**

Table 10.4 List of key informants

Agricultural office	Extension team leader	*Fogera Woreda*
Ato Melaku Tadesse	Livestock/fishery expert	*Fogera Woreda*
Ato Dereje	Rural credit expert	*Fogera Woreda*
Ato Tilahun	IPMS/ILRI coordinator	*Fogera Woreda*
Ato Woretaw	Land use and administration expert	*Fogera Woreda*
Ato Mesenbet	Irrigation expert	*Fogera Woreda*
Woreda Water sector	Rural water supply and sanitation focal person	*Fogera Woreda*
W/ro Ayichesh	Gender expert of the woreda	*Fogera Woreda*
Ato Solomon Ewnetu	DA for natural resource	*Kuhar Michael*
W/roThehay Melaku	DA for livestock	*Kuhar Michael*
W/rt Fasika Mekonnon	DA for crop	*Kuhar Michael*
Ato Abraraw Mekuanint	Kebel administration leader	*Kuhar Michael*
W/ro Muluwork	Chair of the kebele	*Kuhar Michael*
Ato Worku Mintesinot	Chair of farmers cooperative	*Kuhar Michael*
W/ro Fitfite Mekuanint	Chair of women legue	*Kuhar Michael*
Mengesha Yile	Chair of Alawuha irrigation coop	*Lenche Dima, Gubalafto*
Arage Alene	Cashier of Alawuha irrigation coop	*Lenche Dima, Gubalafto*
Bete Mariam	Woreda NR experts	Gubalafto
Ato Tilaw	PANP-food security expert	*Gubalafto Woreda*
Ato Mohamed Seid	Vice chair of farmers association	*Lenche Dima, Gubalafto*
Ato Belete Zewdu	DA for livestock	*Lasta Gerado Kebele*
Ato Habtamu Alie	DA, for natural resources, and AMAREW project facilitator	*Lenche Dima*
Emuhay Yiftusira Alemu	Elder (78 yrs woman)	*Kuhar Michael*
Abuhay Mekuanint Mengistu	Elder (93 yrs old man) from church	*Kuhar Michael*
Ato Mengesha	Elder	*Lenche Dima*
Maritu Legaso	Women affairs representative	*Lenche Dima (Kolokobo)*
... .		

Table 10.5 Profile of target farmer respondents in the study sites

1. *Kuhar Michael*

No	Participant Name	Got	Ag	Edu	Sex	well-	Family Size				Livestock types and number/head								Land owned Size (Kd/Td)		Grazing land (Code)	Water Sources used (Code)	Land use status
							Tot	Fe male	Mal	Work ing	Cattle (O/C/OTH)			S	G	D	Ca mel	Others	Irrig-able	Not Irrigable			
1	Qenu Fentahun	Barage	38	R+W	WH	Medium	5	4	1	2	1	1	1	0	0	0	0	6Ch	0	4(2r+2m)	C + P	R (Dokma)	RO 2.5
2	Tadilla Birara	Barage	38	R+W	WH	Poor	4	4	0	2	0	0	0	0	0	0	0	0	1	2 (millet)	No ansr	W(Comm)	RO 1
3	Fenta Belay	Barage	35	Illt	WH	Medium	5	2	3	2	1	1	2	0	0	0	0	9Ch	0	4(3r+1m)	C	W	Used all
4	Bizuayehu Belay	Shiwonze	65	Illt	WH	Medium	1	0	1	1	1	0	0	0	0	1	0	0	0	4 (rice)	C + P	W(Comm)+PP	RO+Gi
5	Bagegne Fillate	Barage	50	Illt	WH	Rich	1	0	1	1	0	0	0	0	0	0	0	0	0	4(millet)	No ansr	W(Comm)	RO all
6	Atalel Alebachew	Shiwonze	40	R+W	WH	Poor	3	0	3	1	0	0	0	0	0	0	0	0	0	1(rice)	No ansr	W(Comm)	RO all
7	Muchit Teka	Shiwonze	48	Illt	WH	Poor	3	1	2	1	0	0	0	0	0	0	0	0	0	2(1r+1oth)	No ansr	W(Comm)	RO 1
8	Densa Bere	Barage	46	Illt	WH	Medium	4	1	3	1	0	0	0	0	0	0	0	3Ch	0	6(2r+4m)	No ansr	W(Prvt)	RO all
9	Yeshi Tsega	Shiwonze	45	R+W	WH	Poor	3	2	1	2	0	1	1	0	0	0	0	0	0	2(rice)	C	W(Comm)+PP	RO all
10	Ergo Wotet	Shiwonze	40	R+W	WH	Medium	4	1	3	2	0	2	1	0	0	0	0	3Ch +	0	4(1.5r+2.5 m)	C + P	W(Prvt)+PP	RO 0.5
11	Erkinesh Belay	Barage	42	R+W	WH	Poor	2	1	1	2	0	0	0	0	0	0	0	0	0	0	No ansr	W(Comm)	Family
12	Enanu Haile	Adabit	38	4th	WH	Medium	1	0	1	1	1	2	5	0	0	1	0	3Ch+2H	0.25	4(millet)	C	PP	RI 1
13	Erkinesh Liben	Barage	45	Illt	WH	Rich	3	2	1	2	0	1	1	0	0	0	0	0	0	2(rice)	C	W(Comm)	RO all
14	Ziyin Shumye	Adabit	40	Illt	WH	Rich	2	0	2	1	0	0	0	0	0	0	0	0	0	1(homstead	No ansr	W(Comm)	Used all
15	Like Belay	Barage	28	R+W	WH	Medium	3	1	2	2	2	1	2	0	0	0	0	3Ch	0	3(1r+2m)	C	W(Comm)	Used all
	Average						3.21			2.05													
	r=rice, m=millet,c=communal, p=private, pp=pipe, w=well, ch=chicken, H=hive, WH=women headed, R=river,R+W=writing and reading, Illt=Illitrate, RO=rent out, RI=rent in																						
16	Bayat Naqe	Doqmit			MH	Medium	7	2	5	6	3	4	3	0	0	1	0	2Ch	1	2	C	PP,R,S	O+RI
17	Shashe Mesfin	Doqmit			MH	Medium	6	3	3	6	2	2	2	0	0	0	0	3Ch	1	2	C	PP,R,S	O+RI
18	Muchit Alemu	Adabit			MH	Poor	5	3	2	4	2	1	0	0	0	1	0	2Ch	0	2	C	R (Adabit)	O
19	Gebeya Zeleqe	Shiwonze			MH	Rich	7	4	3	4	2	2	2	0	8	1	0	0	1	2	C+P	R (Shiwonz)	O+RI
20	Abetu Amlak	Barage			MH	Medium	7	2	5	6	3	3	2	0	0	1	0	3C+3H	2	2	C	W	O+RI
21	Abey Kebede	Barage			MH	Rich	7	3	4	5	3	3	2	0	9	1	0	5C+3H	0	4	C+P	W	O

22	Askaby Nega	Yilud			MH	Poor	5	2	3	4	2	3	2	0	0	0	0	3Ch	2	2 1/2	P (5per)	R (Yilud)	O+RI
23	Segedu Kebede	Nora Mender			MH	Poor	8	5	3	5	2	0	3	0	0	3	0	2C+1H	1	4	C	W, PP	O
24	Tega Melke	Barage			MH	Medium	6	2	4	5	2	1	1	5	0	1	0	15C+6H	0	3	P+C	W,PP	O+RI
25	Bishat Liben	Barage			MH	Rich	2	4	6	5	3	1	3	0	0	3	0	1C+3H	2	2	P+C	W	O+RI
26	Ager Mesfin	Yilud			MH	Poor	5	3	2	4	2	1	2	0	0	0	0	4Ch	4	1 3/4	P+	R (Yilud)	O+RI
27	Mulu Abelew	Mesno			MH	Poor	7	2	5	7	3	1	0	0	0	0	0	0	0	6	P+C	PP	O+RI
28	Azalech Gebeyaw	Lualua			MH	Rich	6	5	1	6	3	3	2	0	0	1	0	0	1	7	P+C	W	O
29	Yeshitila Ayele	Shiwonze			MH	Poor	8	4	4	4	1	0	0	0	0	0	0	0	0	5m+4r	P+C	W + Rp.	O+RI
30	Asres Yirsaw	Adabit			MH	Medium	5	3	2	5	2	0	0	0	5	0	0	0	2	2 rice	C	PP(LS+D)	O+RI
	Average						91			76													
31	Sitotaw Birara	Woreg	20	8th	YM	Poor	2	1	1	1	1	0	0	0	0	0	0	0	0	0	C (Open	W(Com) open	RI(6 moth
32	Yiberetal Takele	Woreg	24	Illt	YM	Poor	2	1	1	2	1	0	1	0	0	0	0	1 Ch	0	2	C (Open	W(Cm)+R (Guanta)	RI (1)
33	Eyassu Belay	Woreg	29	R+W	YM	Poor	4	2	2	3	2	3	2	0	0	1	0	3 Ch	0	1	C (Open	W(Prvt)	RI (6fathr)
34	Sintayehu Yalew	Adabit	30	Illt	YM	Poor	6	2	4	3	1	2	2	0	0	0	0	1 Ch	0	1	C (Open	PP(cm)+R (mesno)	RI
35	Alehegn Tensay	Woreg	29	Illt	YM	Poor	4	2	2	2	2	1	1	0	0	1	0	3 Ch	0	1	C (Open	W (Cm) (prvt)	RI (2)
36	Gizachew Birara	Woreg	28	R+W	YM	Poor	3	2	2	2	1	0	1	0	0	0	0	0	0	1	C (Open	W (Cm)	RI (2)
37	Shibabaw Alebachew	Sheheti	28	4th	YM	Poor	4	2	2	3	1	1	0	0	0	0	0	0	0	1.5	C (Open	W (Cm)	RI (2)
38	Melesse Ayichew	Sheheti	21	Illt	YM	Poor	4	3	3	2	2	0	0	0	0	0	0	2 Ch	0	2	C (Open	W (Cm)	
39	Muluneh Nigussie	Nora Mender	22	Illt	YM	Poor	3	2	2	2	2	1	0	0	0	0	0	0	0	1 homestead	C (Open	W (Cm)	RI (1r+0.5Irr)
40	Getachew Ayana	Adabit	26	Illt	YM	Poor	3	2	1	2	1	1	1	0	0	0	0	2 Ch	0	0.25Hom	C(Open) P	W (Cm)	
	Average						35			22													
	YM=Young Male, Shawra river is used for livestock watering since cross the grazing land but not purposely go, chicken joint responsibility for men and women																						
41	Q/Agazce Fetene	Nora Mender	35	5th	Mn	Medium	4	2	2	4	0	2	4	0	0	0	0	7 ch	3	4	C+P(1)	R(Gun)+S(Chiqchaqa)	
42	Getnet Addisu	Mesno	33	Illt	Mn	Medium	4	2	2	3	0	1	0	0	0	0	0	0	0	3	C	R(Mesno)	
43	Wosen Chane	Nora Mender	35	6th	Mn	Rich	7	2	5	7	2	1	2	0	0	0	0	2	1.5	6	C+P(1)	R(Gun)+S	

44	Alemu Muche	Nora Mender	42	7th	Mn	Rich	7	1	6	5	3	1	2	0	0	0	0	20 ch	4	4	C+P(1)	R(Gun)+S	
45	Shashe Gedefaw	Nora Mender	38	R+W	Mn	Poor	7	4	3	6	2	0	0	0	0	0	0	5 ch	0	5	C+P(1)	S	
46	Mulunesh Nigussie	Mesno	22	Illt	Mn	Poor	3	2	1	2	1	0	2	0	0	0	0	7 ch	0	0.25	C	RMesno, S	
47	Moges Nadew	Nora Mender	48	R+W	Mn	Rich	5	1	4	5	2	3	4	0	0	1	0	4 ch	2	5	C+P(1)	R(Mengaloma), S	
48	Asres Alamiraw	Nora Mender	32	3th	Mn	Poor	3	2	1	3	0	0	0	0	0	0	0	2 ch	0.25	2.5	C	R+PP (FINNIDA)	
49	Awulew Tafete	Lualua		R+W	Mn	Poor	3	1	2	3	1	2	2	0	0	10	0	0	0	4	C	R(Mengaloma), S	
50	Ayalew	Nora	34	R+W	Mn	Medium	7	3	4	5	2	1	3	0	0	0	0	8 ch	3	4	C+P(1)	R(Gun)+S(Minchute)	
	Average						50			43													
	Mn=men, From 1992/93 participants of irrigation are members of the irrigation user cooperative.																						
51	Minalu	Mesno	40	R+W	WH	Poor	5	3	2	5	0	0	2	0	0	0	0	0	1 r	3 m	C	R(Irr+Motor)	RO all
52	Bizuye Ageze	Mesno	45	R+W	Wn		6	3	3	6	0	1	0	0	0	0	0	3	2 r	2 .5 m	C+P(0.2	R(Irr+Motor)	RO (2)
53	Emebet	Mesno	27	Illt	Wn		5	1	4	3	1	0	0	0	0	0	0	4 Ch	3 r	1 m	C	R(Irr+Motor)	RO (2)
54	Enat Alem	Mesno	37	3rd	WH	Poor	4	1	2	4	1	0	0	0	0	0	0	0	1 r	2 m	C+P(0.5	R(Irr+Motor)	RO (2)
55	Mareshet Engida	Barage	35	R+W	Wn		7	4	3	5	2	3	2	0	0	0	0	8	2 r	1 m	C+P(2)	R(Irr+Motor), W (Prvt)	RI
56	Wotet Awoke	Barage	20	Illt	Wn		7	4	3	5	2	0	2	0	0	1	0	0	3 r	0	C+P(1)	Well (Prvt)	RI
57	Manale Kassie	Adabit	20	Illt	Wn		6	4	2	4	2	2	2	2	0	1	0	5	1 r	1.5 m	C	R(Ajafej)	RI
58	Metenua Tigab	Barage	23	Illt	Wn		7	6	1	5	2	2	2	0	6	1	0	1	2.5	1.5 m	C+P(1)	Well(Prvt)	RI
59	Mendere Kassa	Barage	38	W			5	3	2	4	0	1	1	0	0	0	0	3	4 r	0	C+P(1)	Well(Prvt)	RO all
60	Belaynesh Wabye	Barage	60	Illt	WH	Rich	3	2	1	3	1	1	4	0	0	0	0	3	3 r	2 m	C	R(Guder)	Given to
	Average						38			28													
							5.2			4.1													

2. *Lenche Dima*

No	Participant name	Got	Age	Edu	Sex	Well-being	Family Size				Livestock types and number								Land size (Kd/Td)		Grazing land (Code)	Water sources used /Code/	Remark	
							Total	Fe-male	Male	Working group	Cattle (O/C/OTH)			Sheep	Goat	Donkey	Camel	Others	Irrig-able	Not Irrig-able			Land use status	Seftynet Participation
1	Hadya Hussien	AK	35	Illt.	WH	Poor	3	1	2	3	0	0	0	0	0	0	0	0	0	2	Hill Prv.	PP Prv.	Rent out	No
2	Shimbra Aliyu	AK	45	WR	WH	Poor	4	3	1	2	0	0	0	0	0	0	0	1 Ch	0	3	Hill Prv.	PP Prv.	Rent out	Yes
3	Enanu Yimam	Wr	50	Illt.	WH	Poor	5	3	2	5	2	0	0	0	0	0	0	0	0	6	Hill Prv.	PPComn	Used by own	Yes
4	Fato Ahimed	AK	21	Illt.	WH	Poor	2	1	1	1	0	0	0	0	0	0	0	0	0	1	Nothing	PPComn	Used by family	Yes
5	Tsehayseged Yimam	AK	60	Illt.	WH	Poor	3	1	2	2	1	0	0	0	0	0	0	1 Ch	0	2	Hill Prv.	PP Prv.	Used by own	No
6	Bissil Mohamed	AK	62	Illt.	WH	Poor	2	2	0	2	0	0	0	0	0	0	0	0	0	3	Nothing	PPComn	Rent out	Yes
7	Tiru Mehamed	AK	28	Illt.	WH	Poor	4	2	2	3	0	0	0	0	0	0	0	3 Ch	0	4	Hill Prv.	PPComn	Rent out	Yes
8	Aregu Abera	AK	55	Illt.	WH	Poor	2	1	1	2	0	0	0	0	0	0	0	0	0	2.5	Hill Prv.	PP Prv.	Rent out	Yes
9	Woynitu Alemu	AK	45	Illt.	WH	Poor	1	1	0	1	0	0	0	0	0	0	0	0	0	2	Hill Prv.	PPComn	Rent out	Yes
10	Aregu Fentaw	Wr	30	3rd	WH	Poor	2	1	1	1	0	0	0	0	0	0	0	0	0	3	Hill Prv.	PPComn	Rent out	Yes
11	Enanu Yassin	AK	80	Illt.	WH	Poor	3	1	2	2	0	0	0	0	0	0	0	0	0	3	Hill Prv.	PP Prv.	Used by own	No
12	Shentem Yimam	AK	50	Illt.	WH	Poor	1	1	0	1	0	0	0	0	0	0	0	0	0	2	Nothing	PP Prv.	Rent out	No
13	Shewanesh Abe	KK	28	3rd	WH	Poor	2	2	0	1	0	0	0	0	0	0	0	0	0	2	Nothing	PPComn	Used by family	Yes
14	Maritu Molla	AK	26	Illt.	WH	Poor	4	2	2	1	0	0	0	0	0	0	0	0	0	4	Hill Prv.	PP Prv.	Rent out	Yes
15	Yelifign Ayalew	AK	30	Illt.	WH	Poor	2	2	0	1	0	0	0	0	0	0	0	2 Ch	0	3	Hill Prv.	PP Prv.	Rent out	Yes
	Average		**43**				**2.7**	**1.6**	**1.1**	**1.9**	**0.2**	**0**	**0**	**0**	**0**	**0**	**0**	**0.5**	**0**	**2.8**				
16	Jenete Adem	Wm	35	Illt.	MH	Rich	6	4	**2**	2	2	2	1	0	0	0	0	0	0	5	Hill Cm	PP+R	Owned used	No
17	Fato Siraj	Wm	25	Illt.	MH	Med	5	4	1	2	2	0	0	0	0	0	0	3 Ch	0	5	Hill Cm	PP+R	Plus 2 rentin	No

18	Ansha Nurye	Wm	30	Illt.	MH	Poor	6	2	4	2	1	0	0	0	0	0	0	0	0	5		PP	Owned used	No
19	Ambash Fentaw	Wm	35	Illt.	MH	Med	5	3	2	2	2	0	1	0	0	1	0	1 Ch	0	4	Hill Cm	PP+R	Owned used	No
20	Aminat Ahimede	Wm	35	4th	MH	Rich	7	5	2	4	2	3	2	0	0	1	0	4Ch	0	5	Hill Cm	PP+R	Plus 3 rent in	No
21	Hadira Mehamed	Wm	27	Illt.	MH	Med	5	2	3	2	2	0	0	0	0	0	0	2Ch	0	6	Hill Cm	PP+R	Plus 2 rent in	No
22	Zinet Tefera	Wm	27	Illt.	MH	Rich	7	4	3	3	2	3	3	0	4	1	0	2Ch	0	5	Hill Cm	PP+R	Plus 2 rent in	No
23	Azimew Ahimed	Wm	35	Illt.	MH	Rich	6	3	3	2	2	4	2	0	5	2	0	2Ch	0	5	Hill Cm	PP+R	Owned used	No
24	Hawaye Yassine	Wk	42	Illt.	MH	Med	5	3	2	3	2	1	0	0	0	1	0	3Ch	0	4	Hill Cm	PP+R	Plus 3 rent in	No
25	Zemzem mehamed	Wk	34	WR	MH	Med	5	2	3	4	2	0	1	0	0	1	0	2Ch	0	6	Hill Cm	PP+R	Plus 1 rent in	No
	Average						57			26														
26	Belay Teshome	Ahg	42	WR	Mn	Med	6	4	2	3	2	0	0	0	0	1	0	6Ch	½	4		PP+R	Plus 3 rent in	No
27	Mekonen Asfaw	Ero	34	Illt	Mn	Rich	7	4	3	5	2	2	3	2	0	1	1	4Ch/ 1H	½	4	Pgl 1K	PP+R	Plus 5 rent in	No
28	Deribe Addissu	Waz	35	6th	Mn	Rich	5	2	3	2	2	2	2	0	2	1	0	2Ch	¼	3	Hill Cm	PP+R	Plus 2 rent in	No
29	Mohamed seid Aragaw	Deb	37	WR	Mn	Med	5	4	1	2	2	1	1	0	0	1	0	4Ch	½	2		PP+R	Plus 4 rent in	No
30	Tefera Molla	Bye	50	4th	Mn	Poor	10	5	5	5	1	0	0	0	0	0	0	≥ 15 Ch	¼	5	Hill Cm	P+S	Plus 3 rent in	No
31	Fentaw Yimer	Min	45	Illt	Mn	Rich	8	2	6	3	2	3	2	0	3	1	0	4Ch	0	7		PP+R	Plus 4 rent in	No
32	Yasin Ahimed	AK	52	Illt	Mn	Med	3	2	1	2	2	1	1	0	0	0	0	4Ch	0	4	Hill Prv	PP+Wh	Plus 4 rent in	No
33	Sied Wolle	Diq	32	Illt	Mn	Rich	4	2	2	2	2	2	4	0	4	0	0	2Ch	0	5	Hill Cm	PP+R	Plus 6 rent in	No
34	Molla Ararse	Wm	68	Illt	Mn	Poor	6	3	3	2	1	0	0	0	0	0	0	1Ch	0	6	Hill Cm	PP	Owned used	No
35	Nuradin Sied	Wm	36	WR	Mn	Med	4	2	2	2	2	2	1	0	1	1	0	4Ch	0	4		PP+R	Plus 3 rent in	No
	Average						58			28														
36	Fentaw Abera Yalew	KK	50	Illt	Mn	Rich	4	2	2	3	2	1	1	0	3	1	0	3Ch	0	5	Hill Prv	PP+P	Plus 4 rent in	No
37	Yimam Ali Marye	KK	60	Illt	Mn	Rich	9	3	6	7	2	2	2	0	0	2	0	2Ch	0	5	Hill Prv	P+Wh	Plus 7 rent in	No
38	Mohamed Yassin	SA	55	WR	Mn	Rich	7	4	3	5	2	1	2	0	2	1	0	3Ch	½	6		PP+R	Plus 3 rent in	No
39	Molla Gushish	KK	32	Illt	Mn	Med	4	2	2	2	2	0	0	0	0	0	0	0	0	6	Hill Prv	PP+P	Owned use	No
40	Mohamed Seid (Vice chair)	KK	44	4th	Mn	Rich	8	3	5	6	3	2	2	0	20	2	0	15 Ch	0	9	Hill Prv	PP+P	Plus 8 rent in	No
41	Yimam Eshetu	KK	36	WR	Mn	Poor	4	1	3	2	0	0	0	0	0	0	0	0	0	4	Hill Prv	PP	Owned use	No

42	Molla Addis						36			25													
43	Yilma Ahmed																						
44	Getahun Degu																						
45	Hassen Ali																						
46	Hussien Nurye	KK	28	Illt	Ym	Poor	3	1	2	2	1	0	0	0	0	0	0	0	0	2	Hill Prv	PP+P		No
47	Ahmed Hussien	KK	25	WR	Ym	Poor	3	2	1	2	1	0	0	0	0	0	0	0	0	2	Hill Prv	PP	Plus 2 rent in	No
48	Yimam Mengesha	KK	27	Illt	Ym	Poor	3	2	1	2	1	0	0	0	0	0	0	0	0	2	Hill Prv	PP		No
49	Yasin Desalew	KK	24	Illt	Ym	Poor	3	2	1	2	2	1	0	0	0	0	0	0	0	1	Hill Prv	PP		No
50	Desale Hailu	KK	26	Illt	Ym	Poor	3	2	1	2	1	0	0	0	0	0	0	0	0	2	Hill Prv	PP	Plus 2 rent in	No
51	Chane Birhanu	Grd	25	Illt	Ym	Poor	1	0	1	1	2	1	1	0	0	1	0	0	0	1		PP+R	Plus 3 (mother)	No
52	Mohamed Kassew	LD	26	5th	Ym	Poor	1	0	1	1	0	0	0	0	0	0	0	0	0	4			rent out	No
53	Sied Molla	LD	27	4th	Ym	Poor	3	1	2	2	1	0	0	0	0	0	0	0	0	1		PP+R	Plus 1 rent in	No
54	Fenta Mekonen	LD	26	Illt	Ym	Poor	2	1	1	1	1	0	0	0	0	0	0	0	0	½		PP+R	Plus 1 rent in	No
55	Nuradis Yimam	LD	25	Illt	Ym	Poor	2	1	1	2	2	0	0	0	0	2	0	0	0	1		PP+R	Plus 2 rent in	No
56	Minshegaw Tefera	Wr			Mn	Med																		
57	Melaku Yalew	AK			Mn	Poor																		
58	Belay Teshome	KK			Mn	Poor																		
59	Yimam Asresie	KK			Mn	Med																		
60	Amarika Gulo	AK			Wm	Poor																		

AK= Addis Kebele; Wr=Wurenew; Wm=; Wk=; Ahg= Abahulagenda; Waz=; Deb=Debisso; Bye=; Min=; Diq=Dishiqe; KK= Kolokobo; SA= Sefied Amba; Grd= Gerado; LD= Lenche Dima

Table 10.6 Farmer respondents for livelihoods case analysis in the study sites

1	Abera Zemenay Belay	Barage, KM	Men Better-off farmer
2	Wondimagegnehu Zeleke	Mesno, KM	Men Better-off farmer
3	Sisay Agmas	Shiwonze, KM	Men Better-off farmer
4	Ergo Wotet	Shiwonze, KM	Women poor farmer
5	Thegaye Melke	Barage, KM	Women poor farmer
6	Tadilla Birara	Aja Fej, KM	Women poor farmer
7	Amognesh Mersha	Lualua	Women young poor
8	Abay Amera	Lualua	Men young medium level
9	Shimbra Aliyu	Addis Kebele, LD	Women poor farmer
10	Aregu Abera	Addis Kebele LD	Women poor farmer
11	Hadiya Hussien	Addis Kebele LD	Women poor farmer
12	Ergo Shibry	Addis Mender LD	Women poor farmer
13	Yelfign Ayalew	Addis Mender LD	Women poor farmer
14	Sheh Hussien Mohamed	Addis Mender LD	Men Medium Level farmer
15	Fentaw Aligaz	Addis Mender LD	Men Poor SN participant
16	Mohamed sied Adem	KoloKobo LD	Men Better-off farmer
17	Desale Belete Gobena	KoloKobo LD	Men Poor SN participant
18	Abdu Yimam Ali	KoloKobo LD	Men Medium level

Table 10.7 Water resource inventory spread sheet

Village name	Source of water	Status or condition before some years	Status or condition now (after some year)	Uses	Users and access/ control by gender	Any contribution for livelihoods and gender equity		Future improvement opportunities and recommendation	Other remarks
						Changes in livelihoods and gender role	How changed		
KM	Lakes			Domestic					
	Rivers			Domestic plus					
	Ponds								
	Springs			Irrigation					
	Irrigation canals			Irrigation plus					
	Reservoirs			Every purpose					
	Borehole deep wells			Drinking and Cooking					
	Pipes			Sanitation					
	Water harvesting structures			Livestock watering					
	Hand dug wells			Relegious					
	Domestic water supply structures			Recreation					
	.			Other uses					
	.			.					
	.			.					
LD				.					
.									
.									
Used for gathering base line information on water resource availability and uses in the study sites from different sources (secondary and/or primary)									

Source: Desalegn S. (Undated). Models for implementing MUS for enhanced land and water productivity, rural livelihoods and gender equity *IWMI, CPWF project 28*

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