Participatory Analysis of Constraints and Opportunities of the Farming Systems of Tikur Inchini, West Shewa, Ethiopia

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This report is the product of the team with equal contribution from the authors whose names are listed above in the alphabetical order.

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International Centre for development-oriented Research in Agriculture (ICRA)
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Foreword

The course program aims at consolidating the participants’ ability to engage in collaborative work with other institutions and disciplines and in more client-oriented, participatory research and development activities.

The 7 week classroom-based preparation phase in Nazret was divided into 6 topics. The first is an introduction to the principles of interdisciplinary team work, which focused on team processes, facilitation and negotiation, work organization and team contract to be able the field teams to rapidly develop a common work procedure and agree on rules of behavior and decision making. This was followed by a short module on the basic of objectives and clarifying the terms of reference of their field study. The second topic includes an introduction to system thinking; agricultural and knowledge systems. The focus was on tools to analyze these systems: modeling, typologies, identification of actors, etc. At each of these two stages (systems and teamwork planning), the practice was based on the participants’ own experience. Participants were asked to work on their terms of reference to define their objectives, draw models of the relevant knowledge and agricultural systems, and identify the missing information, as the basis of their research plan. The third topic is on the principles of client-oriented research. The fourth topic focused on evaluating impacts and setting of priorities. The fifth topic provides participants with the survey tools needed to carry out their field study. Finally, the 6th topic is a period of active field study preparation by the 4 teams joined by their tutors. The preparation will enable each team to recapitulate all the information generated during the 6 preceding weeks, decide on what further information is needed, what tools they expect to use, to collect it and plan accordingly.

The 10-week field studies were conducted in Adet, Ambo, Areka and Holetta. The teams were part time tutored by researchers with experience of such field studies, specially hired for that purpose. Each field study has specific terms of reference, worked out by task force members of the above centers. some of whom are course participants.

The ICRA-EARO in country training course has benefited from the support of several institutions. Funding was contributed by:

- The International center for development oriented Research in Agriculture (ICRA). Through special funding from the Swiss Development Cooperation (SDC)
- The Ethiopian agricultural Research Organization (EARO), through the Melkassa Research Center
- The Royal Netherlands Embassy in Addis Ababa through its project “Strengthening Client-Oriented Research in Ethiopia:
- The department for International Development (DFID) through its Africa, Greater Horn and Coordination department (London) and the British Embassy (Addis Ababa)
- The Netherlands Development Organization (SNV) in Addis Ababa
- FARM Africa, through its Farmers’ Research Projects (FRP) in Awassa, Ethiopia.

Other institutions helped with the preparation of the course in various ways were Alemaya University of Agriculture, Dire Dawa, Ethiopia, the Bureaus of Agriculture of Amhara, Southern and Oromiya National Regional States, and the Royal Tropical Institute (KIT), Amsterdam, The Netherlands. The course coordinators were Dr. Nour-Eddine Sellamna (ICRA), Dr. Aberra Deressa (Melkassa Research Center), and Yali Edessa (Alemaya University, Assistant coordinator). I thank them all for their indulgence.

Abera Deressa, PhD
1999, Malkassa Research Center
<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACA</td>
<td>Ambo College of Agriculture</td>
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<tr>
<td>ACPD</td>
<td>Agricultural Cooperation Promotion Department</td>
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<tr>
<td>ADB</td>
<td>Agricultural Development Bank</td>
</tr>
<tr>
<td>AUA</td>
<td>Alemaya University of Agriculture</td>
</tr>
<tr>
<td>AEZ</td>
<td>Agro-ecological Zone</td>
</tr>
<tr>
<td>BoA</td>
<td>Bureau of Agriculture</td>
</tr>
<tr>
<td>CGIAR</td>
<td>Consultative Group on International Agricultural Research</td>
</tr>
<tr>
<td>COR</td>
<td>Client Oriented Research</td>
</tr>
<tr>
<td>DA</td>
<td>Development Agent</td>
</tr>
<tr>
<td>DoA</td>
<td>Department of Agriculture</td>
</tr>
<tr>
<td>DoH</td>
<td>Department of Health</td>
</tr>
<tr>
<td>DPPD</td>
<td>Disaster Preparedness Program Division</td>
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<tr>
<td>ERSHA</td>
<td>Ethiopian Rural Self Help Association</td>
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<tr>
<td>EARO</td>
<td>Ethiopian Agricultural Research Organization</td>
</tr>
<tr>
<td>EPRDF</td>
<td>Ethiopian People’s Revolutionary Democratic Front</td>
</tr>
<tr>
<td>FYM</td>
<td>Farm Yard Manure</td>
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<tr>
<td>FSR</td>
<td>Farming System Research</td>
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<tr>
<td>HARC</td>
<td>Holetta Agricultural Research Center</td>
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<tr>
<td>ICRA</td>
<td>International Center for development-oriented Research in Agriculture</td>
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<tr>
<td>IAR</td>
<td>Institute of Agricultural Research</td>
</tr>
<tr>
<td>ICU</td>
<td>Input Collection Unit</td>
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<tr>
<td>ITK</td>
<td>Indigenous Technical Knowledge</td>
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<tr>
<td>LUPD</td>
<td>Land Use and Planning Department</td>
</tr>
<tr>
<td>LGP</td>
<td>Length of Growing Period</td>
</tr>
<tr>
<td>MoA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
</tr>
<tr>
<td>ODO</td>
<td>Oromo Development Organization</td>
</tr>
<tr>
<td>PA</td>
<td>Peasant Association</td>
</tr>
<tr>
<td>PED</td>
<td>Planning and Economic Development</td>
</tr>
<tr>
<td>PPRC</td>
<td>Plant Protection Research Center</td>
</tr>
<tr>
<td>PRA</td>
<td>Participatory Rural Appraisal</td>
</tr>
<tr>
<td>R &amp; D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SPL</td>
<td>Scientific Phytopathological Laboratory</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of Reference</td>
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<tr>
<td>ToT</td>
<td>Transfer of Technology</td>
</tr>
<tr>
<td>VCR</td>
<td>Value Cost Ratio</td>
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<tr>
<td>WIBS</td>
<td>Woreda Integrated Base Service</td>
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ACKNOWLEDGMENTS

The Ambo Team would like to thank the farmers who spent their precious time sharing with us their knowledge about the farming system of Tikur Inchini District. Our thanks also go to the local DAs and experts of the district's BoA who assisted us throughout the study. The district's administrator is also thanked for his interest and contributions to this study.

We are very grateful to all EARO and ICRA for organizing the training and all the resource persons, who spent their time giving lectures for the team. Our special thanks go to Dr. Nour Selamna, the coordinator, ICRA, for his lectures and guidance during the first phase of the training. We are also indebted to Dr. Abera Deresa, the National Coordinator, and ICRA for organizing this in-country training and for his assistance during our field study.

Our special thanks goes to the PPRC for hosting the team by providing accommodation, vehicle and computer facilities. We would also like to extend our thanks to Mr. Melaku Alemu, Center Manager, PPRC, for making our stay at the center very pleasant.

We thank Mr. Adugna Wakjira, our tutor, for sharing us with his valuable experience and knowledge. Mr. Mesfin Bogale, PPRC, is also thanked for editing this paper.

Our appreciation goes to the staff of ERSMA, particularly Mr. Atnafu W/Gebriel, for his constructive suggestions and for providing us with a vehicle during the fieldwork. Experts of the West Shewa BoA, ACA, PED, PPRC, and ACPD are thanked for participating on the workshop. We would also like to extend our sincere thanks to all that contributed to this work in one way or another.

The Team
May 1999
The EARO is established to generate, develop and adapt agricultural technologies that focus on the needs of the overall agricultural development and its beneficiaries. It coordinates, encourages and assists research activities in order to fulfill the agricultural development needs of the country. EARO has many Federal Agricultural Research Centers operating in different agro-ecologies. One of these centers is the PPRC, which was established in 1974 at Ambo. This Center has a national mandate to carryout research in crop protection with the aim of finding effective control measures for economically important pests.

In order to fulfill the objectives of the agricultural development strategy of the country, EARO has started to reorient the agricultural research system to make it more client-oriented and demand-driven. It has planned to achieve its goals by strengthening the linkage between the research system and extension service and through ensuring substantial farmers participation in the establishment of the research priorities and development of the research programs. In an attempt to strengthen its efforts, EARO has launched an in-country training program on client oriented research approach which was conducted in collaboration with ICRA. The field study part of the training was hosted by PPRC and carried out at Tikur Inchini district, Western Shewa Regional Zone, Ethiopia.

The ICRA team has analyzed the major agricultural constraints and opportunities of the farming system of the study area with the participation of the farmers. In this report the team has recommended R & D proposals which will be incorporated in the research strategy of EARO.

Melaku Alemu
Center Manager
PPRC, Ambo
THE STUDY WAS CARRIED OUT BY AN INTERDISCIPLINARY TEAM OF FOUR RESEARCHERS FROM AMBO AND BAKO RESEARCH CENTERS AND TWO EXPERTS FROM THE MINISTRY OF AGRICULTURE (MoA). THE OVERALL OBJECTIVE OF THE SURVEY WAS TO ANALYZE OPPORTUNITIES AND CONSTRAINTS OF THE FARMING SYSTEM IN TIKUR INCHINI AND TO FORWARD RECOMMENDATIONS OF FEASIBLE SOLUTIONS FOR THE FUTURE R & D ACTIVITIES.

IN ORDER TO SELECT REPRESENTATIVE SITES FOR THIS STUDY, RECONNAISSANCE SURVEY WAS DONE WITH THE ASSISTANCE OF EXPERTS FROM MoA. PARTICIPATORY RURAL APPRAISAL (PRA) WAS ALSO EMPLOYED FOR THE JOINT ANALYSIS OF THE FARMING SYSTEM BY INVOLVING OVER 210 FARMERS AT VILLAGE AND PEASANT ASSOCIATION LEVELS. GROUP AND FOCUSED DISCUSSIONS, RESOURCE MAPPING, PAIR-WISE RANKING AND PROBLEM-CAUSAL ANALYSIS TECHNIQUES WERE USED TO UNDERSTAND THE FARMING SYSTEM. INDIVIDUAL AND KEY INFORMANT INTERVIEWS WERE DONE TO REFINEMENT THE DATA. MID-TERM AND FINAL WORKSHOPS WERE ALSO CARRIED OUT TO CROSS-REFER AND GET MORE FEEDBACKS ON THE STUDY RESULTS.

THE DISTRICT IS FOUND IN WEST SHEWA ZONE, LOCATED BETWEEN 2200 AND 3023 M WITH A BIMODAL RAINFALL AND THE TEMPERATURE USUALLY RANGES FROM 6 TO 24 ºC. ACCORDING TO THE RECENT AGRO-ECOLOGICAL CLASSIFICATION OF MoA, THE AREA BELONGS TO THE COLD TO VERY COLD MOIST SUB-AFRO ALPINE TO AFRO ALPINE (M3) WITH ONLY ONE SUB-ZONE, COLD TO VERY COLD MOIST MOUNTAINS (M3-7). TWO MAJOR SOIL TYPES ARE FOUND IN THE AREA, THE BLACK-BROWN THAT ACCOUNTED FOR 79% AND THE REMAINING 21% WAS RED SOIL. FOREST AND VEGETATION COVER WAS ABOUT 9.4% AND IT WAS RELATIVELY BETTER THAN THAT OF THE WEST SHEWA ZONE, WHICH WAS ABOUT 4%. THE DISTRICT ALSO HAD GOOD WATER RESOURCES THAT COULD BE UTILIZED FOR DIFFERENT PURPOSES. ITS POPULATION WAS ESTIMATED TO 70,456 (3% OF THE ZONE) WITH AN AVERAGE OF EIGHT PERSONS PER HOUSEHOLD. GENDER ANALYSIS SHOWED THAT WOMEN HAD MORE WORKLOAD AND LESS CONTROL OVER MOST RESOURCES WHEN THEY ARE COMPARED WITH THEIR MALE COUNTERPARTS DUE MAINLY TO SOCIO-CULTURAL REASONS.

THE MAJOR ANNUAL CROPS OF TIKUR INCHINI INCLUDE CEREALS, HIGHLAND PULSES AND OIL CROPS, ENSET BEING THE DOMINANT PERENNIAL CROP. THE LATTER SUBSTANTIALLY CONTRIBUTES TO BOTH FOOD SECURITY AND ENVIRONMENTAL SUSTAINABILITY AS RATIONALIZED BY FARMERS. OF THE CEREALS, BARLEY WAS THE DOMINANT WHILE HORSE BEAN AND LINSEED WERE THE MAJOR ONES FROM PULSES AND OIL CROPS, RESPECTIVELY. MOST OF THESE CROPS WERE GROWN FOR FOOD AND AS CASH SOURCES AS WELL. CROPPING CALENDAR OF THE AREA SHOWED OVERLAPPING OF OPERATIONS DURING LAND PREPARATION, PLANTING AND WEEDING FROM JUNE TO SEPTEMBER AND FOR HARVESTING AND THRESHING FROM AND DECEMBER TO FEBRUARY. THESE OVERLAPPING LED TO SEASONAL LABOR SHORTAGE, WHICH WAS THE MAIN REASON FOR SUB-OPTIMAL CROP MANAGEMENT PRACTICES RENDERED BY FARMERS TO THEIR LESS PRIORITY CROPS.

LIVESTOCK POPULATION OF THE DISTRICT THAT ACCOUNTED FOR ABOUT 2.9% OF THE ZONE WAS COMPOSED OF CATTLE, SHEEP, HORSES, DONKEYS AND POULTRY. THEY WERE KEPT AS SOURCES OF FOOD, CASH AND ALSO AS LIVING BANKS FOR THE FARMERS. PASTURE WAS THE MAIN SOURCE OF FEED AND IT WAS DOMINATED BY UNPALATABLE Pennisetum shemperi. Feed scarcity was very common during the dry seasons of December to March, drastically affecting the performance of most animals. Seven major diseases are also recorded to impair the productivity of these animals. Crop-livestock integration was tremendous in the area as animals provide draft power, manure and other services to crop production. Similarly, most of the animals were dependent on crop residues for feed especially during the dry seasons.

ANALYSIS OF MAJOR CONSTRAINTS IN THE FARMING SYSTEM SHOWS THAT SOCIO-ECONOMICS, AGRO-CLIMATIC, AND INSTITUTIONAL FACTORS WERE FOUND THE MAIN REASONS FOR LOW PRODUCTIVITY OF AGRICULTURE IN TIKUR INCHINI. THE INCREASINGLY GROWING HUMAN POPULATION HAS LED TO THE TOTAL EXPANSION BUT REDUCTION PER HOUSEHOLD OF FARMLANDS, AT THE EXPENSE OF FOREST AND PASTURELANDS. THE DECREASING OF FARMLANDS PER HOUSEHOLD
resulted in reduced fallow system and continuous cultivation which was the major cause for the declining of soil fertility, increased pests and shortage of feeds. These problems have contributed to poor health of animals and caused oxen shortage that limited crop production in addition to other problems like frost and high prices of inputs. Among these constraints, the declining of soil fertility, insect-pests and diseases and feed shortage were identified as the top priority for in-depth analysis in search of alternative solutions in collaboration with the relevant stakeholders.

The main research and development stakeholders of Tikur Inchini are Ambo and Holetta Research Centers, zonal and district MoA, policy-makers, NGO, input suppliers and the traders. Linkage analysis among these stakeholders was largely medium, in view of the available technologies and their adoption rates for the major problems of farmers.

Therefore, the following research and development recommendations are given:

- more emphasis should be given to improve the total farm productivity by following system- and client-oriented R & D programs. Community-based agricultural development has to be promoted with interactive synergy among researchers, extension workers and farmers. Integrated methods of managing soils, pests and diseases are necessary focusing on specific domains.
- participatory and adaptive on-farm research/demonstration activities on soil fertility, crop pests and animal feeds need to be carried out in the next three years by Ambo and Holetta Research Centers in collaboration with the zone and district departments of agriculture and with the NGOs. Local resources need to be mobilized and innovative capacity of farmers has to be strengthened for relevant and cost-effective results.
- suitable policy environment that enables strong and productive institutional links are very essential to implement demand-driven R & D activities particularly in this district and generally in the country. Power of farmers and their organizations have to be increased to influence R & D process and direction. More bottom-up decision making approaches are needed. Ways and means of arresting environmental degradation have to be implemented for sustainable and productive outputs.
- Gender roles should be considered in R & D programs and both women and men need to participate in solving constraints of this farming system.
- The development agents, who are involved in dual activities, should curtail extra-curricular activities and give more focus to extension services.
- Formal or informal credit institutions should be established on participatory or cooperation basis. Supporting policies of prices, land and other natural resources are also vital. The government should encourage private or public grain trading enterprises to purchase the grains when prices fall and sale them back at a fair price when they rise.
- Effective family planning has to be encouraged and promoted.


Maamilootti qorannoof fi misooma yero ommaa kana aanaa Tuqur incinnitiitii hojjechaa jiran qorannooyeenyaa midhaanii, qorannooyeen Hoolotaan, qonnaa godina lixa Shawaafii aanaa, wixxantoota imaamataa, “ERSHA”, diheessosta laf-seentuu fi daldaltoota dha. Wal-quntamintii isaanii kana duraa giduu-gala yoo ta’u gara fuulduuartaal cinnaa akka waliin hojjetan malameera.

Maloota dhahaman keessaa:

• Carraa galli ganni qonnaa daraan guddisuf qorannooy fi misooma maamilootta-bu’uressate gaggheessuddaagaa gahee-qabdoota sirna qonnaa kanaan haala mijaawaa tahaniin akka waliin borgina lafa qonnaa, ibjisotaa fi dhukkub midhaanii irratti hojjetan,
• Maamiloottoti hirmaachisuudhaan qorannooy fi misooma borgina lafa qonnaa, ibjisotaa fi dhukkubootaa midhaanii akkasumas hangina nyaaata beeyladoota irratti Aambootaa kan argamu qorannooyeenyaa midhaanii, qorannooyeen Hoolotaan fi beekootaa qonnaa tiin gaggeessuu
• Imaammatu gahee-qabdoota sirna qonnaa walitti fiduu fi haala beekumsii fi odeefannoon walkeessa faaca u wixxanuun qorannooy fi misooma fedhii-qabeessa ta’e ummuf gar-gaara.
• Qorannooy fi misooma maamilootta-bu’uressate yoo jennuus gaheen dhabtootaquddina fiduuwaan guudda taheef qorannooy fi misooma keessatti daraan haammatamanii akka hojjetan,
• Rakkinii maallaqaa qoteebulaa hir’isuuf qotee-bulootu kan hundeefate garee liiji kennanii fi tajajiltii midhaan bittaa fi gurgurtuuna haala gatti isaaniiitii kan kennan dhaabachuu qaban kan jedhanii fi;
• Baayyyna namootaa hir’isuuf qotee-bulootni akkaataa fi lakoofsa maatti isaanii kan murteessu imaamatti bahuu qaban kan jedhan maloota dhahaman dha.
Chapter 1

INTRODUCTION

1.1. Background

Ethiopia has a substantial agricultural potential. However, a persistently low crop yield and sharp decline in per-capita agricultural output characterize the sector. To improve the low productivity, agricultural research was started in the mid-1960s. Since then, several technologies have been developed. However, farmers could not take up most of these technologies, and agricultural productivity remained low. One of the reasons is the traditional top-down research and development (R & D) process followed. To change this, farming system research (FSR) approach was introduced in the 1980s. However, the involvement of the farmers remained low. In an attempt to build on this, a Client Oriented Research (COR) approach is being promoted with the participation of the International Center for development-oriented Research in Agriculture (ICRA), the Ethiopian Agricultural Research Organization (EARO) and the Alemaya University of Agriculture (AUA).

ICRA was established in 1981, through the initiative of European donors contributing to the Consultative Group for International Agricultural Research, CGIAR (Mettrick, 1993). The ICRA training program aims at strengthening the capacities of agricultural research organizations in developing countries to conduct multidisciplinary and interactive research, involving the clients of research (farmers, extension agencies, NGOs and development projects). It encourages the identification of priority research needs and the formulation of proposals for COR activities that address these needs. Since its creation, it has conducted 23 six-month international training programs and 91 multi-disciplinary three-month field studies in 31 countries (including Ethiopia) in which over 450 scientists participated.

Some of the earlier Ethiopian ICRA participants have taken up position of influence and promoted the formation of multi-disciplinary teams and the involvement of the clients in the research process. These efforts have led ICRA to sign a tripartite partnership agreement with the former Institute of Agricultural Research (IAR) and AUA. At the request of EARO the former IAR, and AUA, an in-country ICRA training program has been organized for Ethiopian scientists and development workers. This is believed to create the opportunity for the training of a large number of Ethiopians in a short period of time. It is also believed that the training will bring into focus Ethiopian problems, and facilitate the building of effective linkages among institutions and with farmers. Formulation of joint proposals for COR research activities is also an expected output of the program.

This first ICRA-EARO in-country training started on January 11, 1999 at Nazareth. The training program had two phases. The first phase encompassed seven weeks of knowledge acquisition in Nazret. It covered introduction to principles of interdisciplinary teamwork; system thinking; agricultural and knowledge system; principles of client-oriented research; evaluation of impact; the setting of priorities; familiarization with survey tools needed to carry out field studies and a period of active field study preparation with a tutor. The second phase consisted of 10 weeks of field study at Tikur Inchini district.

During the training, participants were divided into four multi-disciplinary teams. The Ambo team is composed of EARO and MoA professionals with different backgrounds: plant pathology, entomology,
animal science, agronomy/soil science and socio-economics.

EARO is responsible for generation, improvement and adoption of technologies. It coordinates, encourages and assists research activities in order to fulfill the current and long-term agricultural requirements of the country (Negerit Gazette, 1997). The organization has many Federal Agricultural Research Centers operating in different agro-ecologies. One of these centers is the Plant Protection Research Center (PPRC) which was established in 1974 at Ambo. This center has a national mandate to carry out research in crop protection with the aim of finding out effective control measures for important pests. The center has been providing services in pathology, entomology, weed science and biotechnology.

1.2. Study area and objectives

Tikur Inchini district is located in West Shewa zone. It has a crop and livestock mixed farming system. The major crops grown are small cereals and enset. The livestock population is also high. However, the productivity of both crops and livestock is very low. Some farmers or no attempt has been made to identify the constraints and opportunities of the farming system, dynamic systems perspective and to propose system oriented, integrated and participatory ways of managing the constraints. The study was, therefore, based on a jointly (EARO and ICRA) developed objective of the center (TOR) and undertaken by the Ambo team from March to May 1999 with the following objectives:

- to identify and prioritize the constraints and opportunities of the farming system of Tikur Inchini district;
- to relate these factors to specific constraints in farm management;
- to analyze socio-economic factors of the farm household in the study area and develop farm typologies in view of better managing the constraints;
- to analyze the existing indigenous knowledge held by farmers and other relevant stakeholders in order to identify potential solutions to address the problems;
- to forward recommendations regarding ways of strengthening farmers’ involvement in R&D activities in order to increase their efficiency; and
- to formulate research proposals for priority R&D activities to be implemented by the host center PPRC in collaboration with farmers and other relevant stakeholders.

Study output

The major output of this field study includes a description of the farming system, a prioritization of the constraints and opportunities and a formulation of R&D proposals for future endeavors.
Chapter 2

METHODOLOGY

Major steps

Before departing for the field study, secondary data were collected, analyzed and several meetings were held to share experiences with the other ICRA teams in Nazareth. Then, the first draft of the research questions, checklists, and outputs needed were formulated in accordance with the TOR. A day before departure, the field plan was presented to the ICRA teams, coordinators, and the tutors. The objective was to collect comments on the draft and discuss issues like real involvement of farmers in the study. Inter-institutional linkage analysis was identified as a topic to be given emphasis. Generally speaking, the study, methodology has employed literature review, direct contact with different stakeholders, reconnaissance survey, participatory rural appraisal and workshops as described below.

2.1. Secondary data collection

Prior to the field study, relevant secondary data were collected from the Department of Agriculture (DoA) at zonal level, Office of Agricultural Development at district level, PPRC, HARC, and ERSHA. Secondary data on both livestock and human population, infrastructure, stakeholders working on Tikur Inchini farming systems, extension services and related problems were collected from MoA and Planning and Economic Development (PED). Past R & D efforts along with their problems were also identified from PPRC, HARC, and ERSHA. Information on the past loan extension schemes and the new policy for private sector encouragement was obtained from the Agricultural Development Bank (AID bank). Staffs from the Agricultural Cooperative Promotion Department (ACPD) were also interviewed for their on going and would be strategies. These data were used to further modify the field study plan and rectify the quality of information required. After the primary participatory data gathering, secondary data were collected from ADB, PED and ACPD. It was also agreed that secondary data collection needs to be an iterative process and should continue up to the end of the study periods.

2.2. Reconnaissance survey

To better understand the real constraints of the system and focus the primary data collection process, the team agreed that selection of sites representative of Tikur Inchini district was indispensable. Out of the 19 PAs in the district, the team made a reconnaissance survey in six of the accessible ones: Ula-lankisa, Waldo-Hine, Wine-Guyama, Homi-Hane, Nanno-Jidu, and Bilo-Abayi. Experts from BoA, and the tutor also participated in this survey. Informal discussions were also made with the BoA and development agents (DAs) to set the selection criteria for representative PAs. The criteria used included representativeness, accessibility, and availability of DAs to carry out the study within a given time and resources. Based on these criteria two PAs, Bilo-Abayi and Nanno-Jidu, were selected.

The team discussed on the information gathered in a holistic manner to refine the field plan and incorporated it into the checklist. Different data types, which could be collected at different levels such as district, PA and village, were discussed. Similarly, data that could be obtained from secondary
sources and farmers were identified. On the following days, those data were collected from the respective sources as per the methodological protocols.

2.3. Pre-mid-term workshop PRA

Methods for primary data collection
The full involvement of clients will form the basis for future R & D. Participatory problem identification, which is the major trust of ICRA’s training, is believed to increase the efficiency of R & D. With this in mind, participatory data gathering was conducted by a multidisciplinary team with the assistance of BoA staff. The team facilitated the interaction between farmer groups to better understand their problems and, accordingly, used different PRA tools. The major PRA tools used for this survey were pair-wise matrix ranking, seasonality analysis (crop/labor/feed and rainfall calendars), resource mapping, historic profiles, transect walk, field observation, and wealth ranking. A total of 210 farmers, taking into account gender compositions, participated at PA and village level (Table 2.1).

Table 2.1 Number of farmers sampled per PA/villages by gender

<table>
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<tr>
<th>PA</th>
<th>Village</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nano-Jidu (29)</td>
<td>Gabate</td>
<td>27</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Nanno-Jidu</td>
<td>25</td>
<td>16</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Jabdu</td>
<td>5</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Bilo-Abayi (29)</td>
<td>Kotiye-Gadi</td>
<td>14</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Genu</td>
<td>17</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Wale</td>
<td>9</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Kotiye-Oli</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Roge-Danisa</td>
<td></td>
<td>7</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Bola-Roge</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Subtotal (58)</td>
<td></td>
<td>110</td>
<td>42</td>
<td>152</td>
</tr>
<tr>
<td>Total number of farmers participated</td>
<td>58+152 = 210</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Two translators were identified and recruited from Tikur Inchini BoA. Time was spent orienting them about how the field study plan would be implemented and what was to be achieved. The PRA exercises were done both at PA and village levels as follows:

PA level
To make farmers more familiar with the PRA tools and investigate their major resources, resource mapping was made by groups of farmers. Since these resources might vary over the years, the mapping was designed to show both recently introduced resources and the already existing ones. Farmer groups, facilitated by the team, did pair-wise rankings of major crop production constraints. Livestock production constraints were also ranked using the same matrix. These rankings of farming problems were made both at PA and village levels. The main objective of using pair-wise matrix was to rank problems in order of importance. Crop, feed, labor, and rainfall calendars were prepared at PA level to collect data on peak season problems like labor and feed shortage. It was also important to judge how many farmers realize seasonal changes as related to crops, livestock and natural resources. Elder farmers were also asked to show changes in farming systems using as reference points different regimes such as Emperor Haile Sillasie’s, Dergue’s, and EPDRF’s. This was meant to catch and verify changes based on the data obtained from group discussions. Farmer key informants were also interviewed for the same reason.

After ranking the problems and completing other relevant works at PA level, setting criteria for selection of representative villages was the major step followed at both PAs. Farmers selected two
villages per PA using their own selection criteria. Those criteria were frost incidence, crop types, soil fertility status, forest cover, farm size, and topography. The selected villages were Genu and Kotiyegadi from Bilo-Abayi; Nanno and Gabate from Nanno-Jidu. After completing the PRA exercises and discussions at PA level, appointments were made to carry out at the village level.

**Village level**

Data related to specific crop and livestock production problems, gender roles, and other socioeconomic constraints were given emphasis at village level. Data on the first two were collected and prioritized using pair-wise ranking; on gender roles, using gender analysis techniques (routine men/women activity profile, access and control over resources, specific activity profile). By interviewing groups and/or individuals, the team collected information on most of the socioeconomic constraints. To develop farm typology, key informants also did wealth ranking.

**General techniques used**

During the first week of field study, all the team members worked together to get acquainted with the farm community so as to create a good rapport for next days data collection using PRA tools. On the second week, a division of labor was made based on the type of data to be collected and the experiences of the team members. This sharing of tasks was one of the useful methods used by the team throughout the study period.

The team held short meetings to discuss the information gathered, problems encountered and ways of solving them. Care was taken not only to observe but also to minimize domination during the discussion. This was done by asking the dominant group or individual to give chances for others did this. In addition, individual and key informant interviews were made to further rectify the quality of the data collected from the group discussion. Experts from zonal DoA (West Showa), ERSHA, PPRC, ACA also participated on the discussion.

**Methods of data analysis**

The team followed its plan of activity to collect, compile and summarize data. Most days, there were informal and/or formal discussions among team members on the data collected and the quality of the procedure followed to collect them. Improvements on the previous day’s experiences were always made in preparation for the next day’s work. A team contract was effectively used to understand, shape, and enlighten one another and to overcome conflicts that arose during the entire field study period. In most cases, consensus was considered as the best means to make decisions.

Data compilation and analysis was started just after the first week of the survey. It was agreed by the team that the sooner it started compiling and analyzing data, the better would be the quality of information generated. In collecting and analyzing the data, different qualitative assessments were made. These were problem definition, specification of objectives, and determination of expected outputs by considering the farmers’ views during PRA, secondary data collection, experiences of the team, and intuitions during the survey.

**Analysis of constraints and opportunities**

As the topic of the study reveals, analysis of constraints and opportunities was a major analytical technique. The team also met for brainstorming on the nature of system interactions and concepts to be used. Researchability, incidence and severity of constraints, and availability of technologies were considered in ranking of the problems at village, PA and mid-term workshop besides prior experiences of the team, and field observations during these constraints analysis. The team also discussed means (opportunities) through which these constraints could be solved. Some of the problems call for policy
changes, institutionalization of COR, training of more development agents, taking into account gender composition, and specialization of production according to comparative advantages.

**Problem tree**
The problem tree was used to picture the cause-effect relationships between different factors influencing the farming system. Visualization in a problem tree form was used as one of the analytical methods. The team did the cause-effect analysis for the core problem like low crop productivity, declining soil fertility, etc. on individual and group bases to generate a more reliable information.

**Problem ranking**
The team did rankings of production problems at different levels during the survey. Rankings were also made by farmers’ and experts’ groups at the mid-term workshop. These were used to further qualify the information compiled and to identify focal areas for further studies.

**Case studies**
To further verify data, case studies were conducted with individual farmers using semi-structured checklists. A case study on the economics of fertilizer use was made to compute rough estimates of value-cost ratio (VCR) for crop(s) applied with fertilizer, and thereby verify farmers’ assertions on the increasing trend of fertilizer price. It was also meant to assess the views of farmers regarding future fertilizer utilization and strategies. Another case study was conducted on the trend of the farming system. A lot of information was collected from group discussions and PRA, but there was a need to validate these data as well. (Value-cost ratio = net benefits due to fertilizer, citrus paribus, divided by costs of fertilizer plus application), was used to assess the opportunity cost of fertilizer. Data obtained from this case study were used in developing household typologies to avoid giving blanket recommendations and so as to propose a way for increasing the efficiency of research. On the other hand, the aim of the second case study was to verify information obtained from group discussions during the survey, and compare the information of a farmer with those of farmers’ groups.

2.4. Post-mid-term workshop PRA

During a mid-term workshop, priority setting was made using a list of problems related to crop and livestock productions. Taking this priority list, farmers’ rankings at different villages, research capacity, secondary data and the experiences of the team into account, three focal areas for the post-mid-term workshop survey were developed. These were soil fertility decline, crop pests and feed shortage. The team agreed that capitalization of the number of PAs and villages from the previous PAs has an immense importance. To scale-up or capitalize the PAs or villages, the severity of the problems of focal areas were taken as the criteria. The new PAs selected included Rogge-Danisa and Bola-Rogge. The former was chosen for its soil fertility problem. The second PA was selected for its critical feed shortage and crop pest problems. The villages selected for problems of crop pest (chaffer grub), soil infertility, and feed shortage were Kotiye-Gadi, and Wale. PRA exercises were done with these PAs and villages.

Regarding the core problems, the team developed a focused checklist for key informants and relevant stakeholders. A problem tree developed by the team, through interview with key informants and stakeholders, as used to refine the ones developed earlier. Historical trends were recounted by elders for each of the focal areas to better understand the changes of the system due to changes in the nature of the problems. This also enabled the team to identify potential entry points into the problems and interventions or leverage points.
2.5. Workshops

2.5.1. Planning workshop

Upon arrival at PPRC, a planning workshop was held to present the field study plan to some of the stakeholders with the main objective of getting their reaction. Important comments from the workshop participants were incorporated. A total of 27 participants attended this workshop, from ERSHA, PPRC, ACA and zonal DoA (West Shewa).

2.5.2. Mid-term workshop

A mid-term workshop was held on March 31, 1999 at district town of Tikur Inchini. Its main objectives were to verify information gathered from farmers and other organizations, prioritize farming problems and identify focal areas for the second phase of the survey. A total of 40 individuals participated, 20 of which were farmers from different peasant associations. The remaining 20 were experts from PPRC, ERSHA, West Showa zonal administration, zonal agricultural cooperatives promotion department, zonal planning and economic development, and district administrator and development personnel. The national ICRA coordinator, Dr. Abera Deresa, and the tutor of the team, Mr. Adugna Wakjira also participated. There were two major sessions. The first session was a presentation of the major findings. Thorough discussions took place and the participants forwarded important comments. Farmers actively defended the very challenging questions raised by the experts to the team. The workshop presented an opportunity to demonstrate how and why farmers’ participation at all the stages of research, i.e., from problem identification to technology utilization and post-evaluation is very important. On the second session, participants were divided into two groups for priority setting: Farmers and DAs in one group, and experts in another. Both groups ranked the problems using different criteria. Farmers’ criteria were, mainly on the severity of the problem. On the other hand, experts used criteria like research capacity, researchable and non-researchable, availability of technologies, information from different sources, and efficiency of farmers’ controlling practices. The resulting matrix rankings were almost similar except that some expectations led farmers to take some policy problems as prior problems. Participation of the farmers was more intense than expected.

2.5.3. Final workshop

A final workshop was held on May 6, 1999 at PPRC, Ambo. The major task was presentation of results to the stakeholders with an emphasis on the effectiveness of farmers’ (women and men) participation in R & D, and collection of constructive comments for the final write-up. Over 30 participants attended this workshop and it was highly interactive.
Chapter 3

DESCRIPTION OF THE STUDY AREA

3.1. Location and Land Area

Tikur Inchini district is located in the Oromiya National Regional State. It is one of the 23 districts in West Shewa Administrative zone. This district is located about 165 and 39 km west of Addis Ababa and Ambo (zonal town), respectively. It is bordered by Ambo district in the north, north east and east; Amaya district in the south east; Nonno district in the west and southwest and Chelia and Danno districts in the north west. This district is located within Abbay (Blue Nile) river basin and shares the same watershed. Tikur Inchini district covers a total land area of 53,806 hectares. It is estimated that the total land area of the district accounts for about 3% of the total area of West Shewa zone.

3.2. Physical Characteristics

3.2.1. Physiography and Altitude

The topography and terrain of the district consists of moderately dissected landforms with plateaus, hills and flat lands. Generally, the relief condition of the study area covers rolling to hilly plateau, gentle slope land forms to rolling high plateau and mountain areas. Within the district there are medium-range mountains some of which are listed below:

<table>
<thead>
<tr>
<th>Mountain</th>
<th>Elevation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agalo</td>
<td>3023</td>
</tr>
<tr>
<td>Dabale</td>
<td>3017</td>
</tr>
<tr>
<td>Mute</td>
<td>2690</td>
</tr>
<tr>
<td>Bajo</td>
<td>2687</td>
</tr>
</tbody>
</table>

Generally, the district is located within altitude ranges from 2200 to 3023 m. However, the major part of the land area especially the arable lands and most of the pasturelands are found within 2400 to 2600 m.

3.2.2. Rainfall

The rainfall pattern in the study area is bimodal. Rain starts in February and extends up to October with short dry period in May. The highest rain comes during the months of June, July and August. Locally this period is called “ganna” which means the big rainy months, and it corresponds with the main cropping season. The lowest rain comes during the month of October. It is not unusual to have untimely rains during November and December, which according to farmers’ perception have negative impacts on crop production as commented below by a farmer at Bilo-Abayi PA.

Rain coming in October is very essential and productive. We feel happy and confident when rain comes in October. Because the yield of our crops will increase. Since barley in October is at seed setting stage, the rain contributes to increase yields. By then, we have to be ready to prepare more and bigger stores for our grains. However, we feel angry and sad about rain coming during November and December and January because such rains are destructive to matured crops. If such cases happen, we have to prepare ourselves to purchase grain both for consumption and seeds for the next season.

Rain coming in October is very essential and productive. We feel happy and confident when rain comes in October. Because the yield of our crops will increase. Since barley in October is at seed setting stage, the rain contributes to increase yields. By then, we have to be ready to prepare more and bigger stores for our grains. However, we feel angry and sad about rain coming during November and December and January because such rains are destructive to matured crops. If such cases happen, we have to prepare ourselves to purchase grain both for consumption and seeds for the next season.
The study area generally enjoys an extended period of rainy season. According to farmers, there is rain in the area for about 9 months. However, there is variation in the amount of rain during the various months. This is demonstrated by the number of rainy days per month as described by farmers (Table 3.1).

![Image: Monthly rainfall (in mm) at Tikur Inchini for 1994-1996]

Source: National Meteorology Authority, 1997

Fig 3.1. Monthly rainfall (in mm) at Tikur Inchini for 1994-1996

<table>
<thead>
<tr>
<th>Month</th>
<th>Rainy days</th>
<th>Month</th>
<th>Rainy days</th>
<th>Month</th>
<th>Rainy days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Nil</td>
<td>May</td>
<td>15</td>
<td>Sep</td>
<td>15</td>
</tr>
<tr>
<td>Feb</td>
<td>4</td>
<td>Jun</td>
<td>21</td>
<td>Oct</td>
<td>5</td>
</tr>
<tr>
<td>Mar</td>
<td>8</td>
<td>Jul</td>
<td>25</td>
<td>Nov</td>
<td>Nil</td>
</tr>
<tr>
<td>Apr</td>
<td>20</td>
<td>Aug</td>
<td>30</td>
<td>Dec</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Generally, the study area obtains adequate rainfall during the main cropping season. The annual average rainfall at Tikur Inchini is about 1700 mm with a range of 900 to 1200 mm. Nevertheless, from mid-October to January, dry weather conditions prevail which sometimes extends up to March. During these dry months severe animal feed shortage occurs in the area.

Farmers' perception on rainfall can be summarized as follows:
- there is a change in the rainfall pattern;
- in the past there was rain even for 12 months;
- now the onset time has changed to February;
- rainfall reliability has decreased;
- there is a decrease in both amount and distribution; and
- untimely rains severely affect crop yields.

### 3.2.3 Temperature

The prevailing temperature in the study area is usually cool and temperate type. The mean annual values for the maximum and minimum temperatures are 24°C and 6°C, respectively (Fig. 3.2). The highest temperatures are recorded during February, March and April while the lowest temperatures occur during October, November and December. These latter months usually correspond with a frost period.
Perception of farmers' on temperature and frost
- frost and its severity shows an increasing trend,
- frost damage is more severe in low-lying and open lands,
- frost affects every crop including enset, pasture and trees,
- damages are less severe around homesteads, mountains and forests; and
- so far, no attempts have been made by any institution to support farmers in combating frost problems.

Agro-climate
Traditionally, the agro-climatic zones of the country are divided into kolla, woima dega and dega although there is no clear distinction of their boundary limits. As population pressure increased and agricultural activities expanded, two additional zones, namely bereha and wurch, each at higher and lower temperature limits were recognized. The traditional agro-climatic zones of Ethiopia including that of the study area and their main features are presented in Table 3.2.

Table 3.2. Traditional agro-climatic zones of Ethiopia.

<table>
<thead>
<tr>
<th>Agro-climatic Zone</th>
<th>Climate</th>
<th>Altitude (m)</th>
<th>Temperature (°C)</th>
<th>Rainfall (mm)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bereha</td>
<td>Hot arid</td>
<td>&lt; 500</td>
<td>Max: 27.5</td>
<td>Min: -200</td>
<td>Not found in the study area</td>
</tr>
<tr>
<td>Kolla</td>
<td>Warm semi-arid</td>
<td>500-1800</td>
<td>Max: 24.6</td>
<td>Min: 200-800</td>
<td>Not found in the study area</td>
</tr>
<tr>
<td>Woima dega</td>
<td>Cool semi-humid</td>
<td>1800-2400</td>
<td>Max: 18.5</td>
<td>Min: 800-1200</td>
<td>Exists in the study area</td>
</tr>
<tr>
<td>Dega</td>
<td>Cool &amp; humid</td>
<td>2400-3200</td>
<td>Max: 16.5</td>
<td>Min: 1200-2200</td>
<td>Exists in the study area</td>
</tr>
<tr>
<td>Wurch</td>
<td>Cool &amp; moist</td>
<td>&gt;3200</td>
<td>Max: 11.5</td>
<td>Min: &gt;2200</td>
<td>Not found in the study area</td>
</tr>
</tbody>
</table>

Source: MoA and field survey, 1999

The study area is classified into two different traditional agro-climatic zones locally called “Badda” and “Badda Darree” representing dega (high altitude) and woima dega (mid altitude) areas, respectively.
In the study area the dega and woina dega climatic zones, respectively, account for about 408,926 and 129,134 sq. km. of land area. Accordingly the respective area coverage of these zones is about 76% and 24% of the total land area of the whole district (Fig. 3.3).

3.2.4. Agro-ecological Zone

The complex landscape of the country displays a striking diversity in climate, vegetation, soil, crop/livestock pattern and farming systems. The recent agro-ecological study made by the MoA (LUPD) has classified the country into 18 major and 49 sub-agro-ecological zones. In the study, the length of growing period and thermal zones are used to describe the major AEZs which are further stratified by using soil resources, physiography, altitude and vegetation cover.

Based on the above classification system the study area is located within the “Moist” major agro-ecological zone. The main characteristics and prime features of this agro-ecological zone are presented below:

- Major AEZ (M3): cold to very cold moist sub Afro alpine to Afro alpine
- Sub-zone (M3-7): cold to very cold moist mountains
- Physiography: plateau
- Rainfall: 1000-1800 mm

The study area is endowed with extended length of crop growing period, which is usually 180-240 days. Rainfall variability is at the lower range normally given to the major zone (15-45%). It has low probability of drought occurrence and immense potential for sheep rearing, forest development and tourism. Conversely, the characteristic features of this sub-zone indicate that the following prime agricultural constraints, as described in chapter six. These include low temperature, erosion, deforestation and rugged topography.

Zonation

The study area is further stratified into different local zones for the purpose of developing appropriate and more homogenous recommendation domains. The major features of these local zones are briefly presented below.

Zone One

This zone includes land areas between 2800 and 3023 m. The landforms in this area are sloppy and mountainous. PAs like Tokie Seden and Rogie Danisa are located in this zone (Fig. 3.4). Such locations...
are within the upper dega agro-climate sub-group. In this area, farmers cultivate sloppy lands for crop production. The cropping system is dominantly barley-based. Very limited highland crops are cultivated. Enset has limited area coverage in the area. Livestock potential is quite low, because pasturelands are most scarce. Soil erosion is the most severe crop production constraint in this zone. Land with over 60% slope is cultivated without any conservation measures. Shortage of water is also quite common. This zone is devoid of any rural infrastructure services. Pest and soil pests are less important in this zone.

**Zone Two**

This zone includes most of the study area. The altitude ranges from 2500 to 2800 m. of the dega area. Mainly black soil types cover this area. The area is dominated by enset cultivation. Soil pest and frost regularly affect production. Hence, chaffer grub and frost are major crop production constraints. Potato is also an essential crop in this zone. The livestock population is immense. Soil fertility decline due to continuous cultivation is wide spread. The area has high population pressure.

**Zone Three**

This zone is found in the lower dega and mid-altitude area of the district with altitude of less than 2500 m. The landform of this zone includes bottomlands with flat and gentle sloppy terrain. Red and brown soils are quite common. The natural vegetation land for it and is dominated by grassland savanna. The cropping system is dominated by tef and wheat cultivation. Barley is also cultivated. Maize cultivation is rapidly expanding in this zone. Low fertility of soil is reported as a common problem in the area. Frost and soil borne diseases cause repeated problems with site-specific and sporadic area coverage. Potato has substantial area coverage of grazing lands and livestock potential. Population pressure is much lower than that of zone two. Although enset has a limited area coverage, it is on an increasing trend of expansion. Private wood lots are being established.

### 3.3 Population

According to the 1994 census, the total population of the district was 70,456. During the same period, the district population covered 3% of the 2,325,660 total population of west Shewa Zone. Currently about 2184 and 71529 of the people in the district are known to reside in urban and rural areas, respectively (Table 3.3). Except a very limited number of people mainly engaged in carpentry, the majorities in the district are the Oromos.

The population growth rate of the district in rural and urban areas was 4.11% and 2.23%, respectively. As far as population density is concerned, it is in the range of 121-140 persons/km², with a mean value of 131. This is a higher figure, compared to the mean value of west Shewa zone (109 people/km²). Tikur Inchini stood 9th out of the 23 districts in West Shewa in terms of population density.

**Age composition**

The youth, the middle and old age groups respectively, hold about 47.5%, 48.0% and 4.5% of the total population. In 1998, about 33,918, 34,384, and 3,251 people with a respective age group of 0-15, 15-65 and over 65 years were living in the area (Table 3.4). Generally, the age composition implies the presence of a broad-based population pyramid with a higher share of young people.

**Sex Ratio**

The sex ratio indicates the total number of males found per 100 females. In 1998, the total number of males and females were 36,110 and 37,603, respectively (Table 3.4). The sex ratio in the district was 96% while the value at zonal level was about 98%.
Dependency Ratio

The dependency ratio indicates the percentage of the population that is assumed to be dependent on the active section of the population (15-65 years of age). The dependent population covers the youth (0-15 years) and the old (65 years and above). The age-based population composition indicates that about 47.5% (youth) and 4.5% (the old) together account for 52% which represents the dependent population size, while the balance is covered by the productive age group (48%). This implies that the dependency ratio in the district is about 108%, meaning that 52% of the population depends on 48% of the population (productive group) for their livelihood. This is a much higher figure, compared with 102% of the zonal average. Although the old age group accounts for only 4.5% the total population, the dependency ratio is higher mainly because of the large youth population.

In general, poor urbanization, young population, high fertility rate, high rate of population increase and high dependency burden are the main features of the population in the study area.

Table 3.3. Population size in Tikur Inchini district

<table>
<thead>
<tr>
<th>Sex</th>
<th>1996/97</th>
<th>1997/98</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>Male</td>
<td>929</td>
<td>34376</td>
</tr>
<tr>
<td>Female</td>
<td>1169</td>
<td>35591</td>
</tr>
<tr>
<td>Total</td>
<td>2098</td>
<td>69967</td>
</tr>
</tbody>
</table>


The population pressure is relatively high in the dega zone, compared with that of the low, mid altitude and mountain areas. It has been estimated that the average family size is seven to eight people per household.

Table 3.4 Population distribution by area, age group and sex of T. Inchini, 1997/98

<table>
<thead>
<tr>
<th>Age group</th>
<th>Male</th>
<th>Female</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15</td>
<td>17811</td>
<td>17183</td>
<td>1076</td>
<td>33918</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-64</td>
<td>16631</td>
<td>18786</td>
<td>1059</td>
<td>34354</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;64</td>
<td>1668</td>
<td>1634</td>
<td>49</td>
<td>3253</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36110</td>
<td>37603</td>
<td>2184</td>
<td>71529</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Table 3.5. Population projection for the study area and the zone

<table>
<thead>
<tr>
<th>Year</th>
<th>District (Thousands)</th>
<th>Zone (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>2000</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>2001</td>
<td>39.5</td>
<td>41</td>
</tr>
<tr>
<td>2002</td>
<td>40</td>
<td>42</td>
</tr>
<tr>
<td>2003</td>
<td>41</td>
<td>43</td>
</tr>
<tr>
<td>2004</td>
<td>42</td>
<td>44</td>
</tr>
</tbody>
</table>

3.4. **Infrastructures**

*Road and Communication*

The district town is linked to Guder by a 25-km gravel road from the main asphalt road, which goes from Addis Ababa to Nekemtie. The same road connects Guder with Shenen (district town of Nonno), passing Tikur Inchini. During 1997 the total length of all weather and dry weather roads in the area was about 32.6 and 3.9 km, respectively. During the same period, only 15 km of the all weather road was graveled.

Although the district town is accessible from the zone town, most of the PAs in the district are inaccessible. Farmers entirely rely on horses for transportation and donkeys for carrying goods. The rural road network needs to be developed. Even the all-weather road needs regular maintenance as there is a serious collapse of this road mainly during the rainy season.

*Schools*

In 1997 there were 15 schools, 4981 students and 126 teachers in Tikur Inchini. There are only primary and junior secondary schools. For secondary education, students must travel to Ambo and Guder. During the same period, the ratio of schooling for children was only 17.38%. In 1998, there were 15 schools, 6302 students and 132 teachers. Again in 1998, the pupil-teacher ratio was 48, while the pupil-school and pupil-school-aged children ratio were 480 and 3371, respectively. The student-teacher ratio is much higher for the district as compared to 34 of the zone average.

*Health*

The rural health service in the district is still underdeveloped. According to secondary data sources, the number of health institutions and health personnel in 1996/97 were 6 and 11, respectively. This figure did not improve in the subsequent year even slightly declining from 27.75% in 1996/97 to 27.13% in 1997/98. Typhoid, internal parasites, pneumonia and tuberculosis are the most common health problems in the area.

*Others*

The district is devoid of electric services even in the district town. In 1997, there was only one postal agent based at the district town. So far, the district does not have any telephone services. Even radio communication is unknown. There is one third class meteorological station at the district town. It collects rainfall, temperature and other weather data.
<table>
<thead>
<tr>
<th>Topography</th>
<th>Steep slope</th>
<th>Sloppy</th>
<th>Flat and undulating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil type &amp; condition</td>
<td>Dark brown, high erosion</td>
<td>Red soil, high erosion</td>
<td>Reddish brown soil, water logging, less erosion</td>
</tr>
<tr>
<td>Water resources</td>
<td>Spring</td>
<td>Spring</td>
<td>River</td>
</tr>
<tr>
<td>Crops &amp; pests</td>
<td>Barley: chaffer grub</td>
<td>Wheat: Chaffer grub &amp; rust</td>
<td>Enset: Bacterial wilt</td>
</tr>
<tr>
<td></td>
<td>Wheat: chaffer grub &amp; rust</td>
<td>Enset: Bacterial wilt</td>
<td>Barley: Rust &amp; chaffer grub</td>
</tr>
<tr>
<td></td>
<td>Enset: bacterial wilt</td>
<td>Tef: rust</td>
<td>Wheat: Rust</td>
</tr>
<tr>
<td>Frost</td>
<td>Seldom</td>
<td>Seldom</td>
<td>Frequently</td>
</tr>
<tr>
<td>Trees &amp; shrubs, animals</td>
<td>Trees are scarce</td>
<td>Trees: more available</td>
<td>Trees: available (afforestation)</td>
</tr>
<tr>
<td></td>
<td>Animals: livestock, sheep &amp; horses</td>
<td>Animals: livestock, sheep, horses</td>
<td>Animals: Livestock, sheep, horses &amp; donkey</td>
</tr>
<tr>
<td>Grazing area</td>
<td>Small</td>
<td>Small</td>
<td>Large</td>
</tr>
</tbody>
</table>

Fig. 3.4. Agro-ecological zonation as described by transect walk
Chapter 4

DESCRIPTION OF THE FARMING SYSTEMS

4.1. Socio-economic characteristics

4.1.1. Household compositions

Information obtained from participant farm households shows a minimum of two young and a maximum of 18 mature family members. On average, a household is composed of 8 members aggregated by age and gender (Chilow et al., 1998). This large family size, especially in Kotiye-Gadi and Gabbie is due to polygamy. A farmer can have more than two wives. This contributed to the rapid increase in population. Labor demand is decreasing due to land fragmentation. Small farms can easily be worked by a small number of people. A rapid growth of population has led to excess supply of labor especially where there is no or little employment opportunity.

A pair-wise matrix was prepared for farmers (men and women) to rank their food and income source(s) and preferences. Farmers preferred crops that withstand the weather and help them survive periods of food shortage, mostly July to October. Enset, which is resistant to major problems like frost and erratic rain, is used as security crop in Nanno-Jidu (intermediate altitude) and as staple food in Bild-Abayi (highland). Nutritionally, it is rich in carbohydrates (Setie, 1996) and is always taken along with milk and milk products, cabbages, pulses, and barley. Also considered as a criterion for preference of the crop for food was its taste. This was, especially, taken into account by the mid altitude farmers (Nanno-Jidu), who preferred tef. On the other hand, the criterion considered in ranking the crop for cash was its market price. Linseed was reported to be the first cash crop of the farm because of its attractive market price. Tef, wheat, barley, maize, cabbage, potato, and enset could also be marketed to cover miscellaneous expenses. The resulting matrix showed that enset was preferred for its comparatively better advantage for family consumption, especially when grain is sold from the granary. Next to barley, farmers also preferred maize. Tef, cabbage, potato, wheat, and enset are also consumed.

In a month, about nine cultural and religious holidays and four Sundays are socially accepted as leisure time. Despite the different perceptions on leisure days, two or three days due to cultural and social beliefs, this large number of days allotted as spare time contribute to the low productivity of the farm communities.

4.1.2. Household resources and gender roles

A family can have farmland, labor, live animals, poultry, farm equipment, household utensils, and crops constituting major household resources. Access and control over these resources depend on the type of household, men-headed or women-headed. In men-headed households, women have the right to use resources like grain, household utensils, poultry and eggs, butter and enset products, and sheep in some cases. They can control the benefits obtained from these resources assuming that the resources are used directly or indirectly for the benefit of the family as a whole. On the other hand, men can have both access and control over highly valued resources such as farmlands, live animals, high market-valued crops (in terms of quantity and type), and farm equipment. This is mainly due to the fact that men are responsible for repayment of public fees (government taxes) and extension credits. In most cases, decision over household resources can be made by negotiation between husband and wife.
A gender analysis was made with the participation of women, men and children. The analysis showed that culture imposes unbalanced workloads among gender groups. Besides household activities such as childcare, cooking, fetching water, washing clothes, house cleaning, milking, collecting firewood, etc., women are also responsible for field tasks like preparation of seedbed for tef, weeding, marketing, and enset processing. As compared to women, men have relatively less work (Table 4.1). They do field works such as land preparation, planting, weeding, harvesting and threshing. Men might also look after cattle when children are gone for school and/or have no child. Boys may also help their fathers in farming activities and sometimes their mothers, by collecting firewood, processing butter and fetching water. In similar fashion, girls spend much of their time helping their mothers by performing household activities expected from women. Unlike boys helping both their mothers and fathers, girls do not perform works reserved for men. This is mainly due to cultural reasons. Boys may help their mothers up to the time they reach puberty. The detail routine profiles for men and women are shown in Table 4.1.

Table 4.1 Daily activities of men and women in Tikur Inchini.

<table>
<thead>
<tr>
<th>Time profile</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-7 a.m.</td>
<td>Awake, feed oxen, construct cattle barn, clear farmland, do some repair of farm implements</td>
<td>Awake, set fire, put calf out of home, clean the house, fetch water, prepare breakfast, boil coffee, do milking</td>
</tr>
<tr>
<td>8-9 a.m.</td>
<td>Breakfast</td>
<td>Breakfast</td>
</tr>
<tr>
<td>9-1 a.m.</td>
<td>Take oxen and required farm implements to the field, plow, plant, weed, harvest, thresh and do other activities depending on the season.</td>
<td>Collect firewood, do gardening, process enset, weed, do marketing, prepare lunch, depending on the requirement of the work type</td>
</tr>
<tr>
<td></td>
<td>Lunch</td>
<td>Lunch</td>
</tr>
<tr>
<td>5-6 p.m.</td>
<td>Take different livestock to the homestead, feed them crop residues and/or tobacco, take them to the kraal to stay over night</td>
<td>Prepare dinner, do milking, process butter, do milling, fetch water etc., as required</td>
</tr>
<tr>
<td>7-9 p.m.</td>
<td>Prepare themselves for dinner, childcare</td>
<td>Go for activities not yet fulfilled b/n 5-6, prepare to have their dinner with their husbands, give dinner to children, clean materials</td>
</tr>
<tr>
<td>9-10 p.m.</td>
<td>Asleep</td>
<td>Asleep</td>
</tr>
</tbody>
</table>


Table 4.1 shows the daily activities of men and women, which should be considered in R & D. Feedback for adoption or non-adoption of improved crop varieties should be expected from either one of the gender groups. For instance, feedback on the quality of the variety for consumption, simplicity of processing, diversity of uses (local alcoholic drinks, food, selling, etc), and color preference for enjera or bread as well as other related traits of a variety could be obtained from women. Similarly, information regarding the agronomic performance and resistance of a variety to different environmental conditions could be collected from men. This is because culture forbids men farmers to discuss these household issues.

Since much of the work is done by women, labor-intensive technologies are expected to be rejected by them. The best example is the comparative advantage of climbing and bushy-type beans (Roba-1) as
assessed by farmers of Bako area. The improved climbing haricot bean is high yielding, provided that timely staking and other agronomic management are made properly. The bushy-type is relatively low yielder, but does not require staking, which saves labor and staking materials. Farmers prefer bushy-type bean because it enables them to save costs of labor, staking and staking materials. In addition to this, the bushy-type bean has better diversity of uses: wont preparation, soup, and other minor uses (Girma and Abdissa, 1998, in press). This type of information is solely obtained from women farmers.

Table 4.2 Access and control profile for men and women in Tikur Inchini.

<table>
<thead>
<tr>
<th>Resources/benefits</th>
<th>Access</th>
<th>Women control</th>
<th>Men control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmland</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Cattle</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sheep</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Poultry</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Milk and milk product</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Enset plant</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Grain harvest</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Horse</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Donkey</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Cash generating activities like locally produced drinks</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Garden crops and their benefits</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>


Key: Yes = Have access to or control over. No = no access or control over

Table 4.2 shows the type of resources gender groups have access to or control over. Culturally, some resources are owned and controlled by one gender group while the other gender group may or may not have access to it. Roughly, from the given data, women control about 42% of the resources together with their benefits compared to 67% by men. Some of the resources are either owned or controlled by both gender groups and children as well. These include poultry, enset plant, and grain; however, the amount might bring inconveniences among men and women. These differences, among men and women, of use and/or control rights over resources have a great effect on contributions expected from women (either of information or heartily involvement) to R & D.

As reported by ERSWA, women have sometimes equal right to participate in agricultural training, saving and credit groups. ERSWA also reported that women are found to be the most active to get rapid awareness and to apply what they have learned. This implies that women farmers should be encouraged to participate actively in R & D activities in the search for food-self sufficiency and improvement of living standards of the people. Prior to the past two decades, women were not allowed to participate in community activities. They had the right to do in-house (gola) activities but no right to either elect or to be elected. Roles of community development and protection were given to men. Since Dergue regime, however, gender issues came into light. Women were given the opportunity to participate in community development activities like terracing, tree planting, road construction, and house-construction. They also served in social or political organizations, run their own associations, had the right to vote and get elected. The EPDRF regime gave the same emphasis to gender roles and equity. However, the policy has not been implemented especially in Tikur Inchini.

4.1.3. Market and Income sources

In Bilo-Abayi peasant association, there are three accessible market places where crops and crop products, poultry and eggs, clothes, cooking materials, and other basic materials are marketed. Large and
small ruminants as well as equines are marketed at two relatively big markets: Guder and Inchini. Mobility of resources in and out of the market is quite free with the exception of livestock. There is a place given for cattle, equines and small ruminants in the market and tax is paid whether the animal is sold or not. In market places like Guder and Inchini, the tax to be paid for single cattle is 12 birr, and 1 birr for sheep and goats. This is very high and not affordable by the resource-poor farmer. For crops and livestock products, no tax is paid.

In most cases, women are the ones involved in marketing family necessities. They sell resources under their control, such as butter, eggs, onions, green pepper, and small quantities of grain, enset products, chicken, locally produced alcoholic drinks and hides of sheep and goats. The benefit goes to the family as a whole in the form of consumables. Some of it may go to women. Men go to the market to sell high valued resources. The money from the sale of these resources goes to the men. The very reason is that men are responsible to pay back credit and clothe the family.

Cash crops, which are mainly cultivated for marketing, include linseed, potato, gomenzer, and sometimes barley, as reported by Bilo-Abayi peasant farmers. The sources of farmers vary from place to place. In Nanno-Jidu PA, farmers made their income source preference using pair-wise matrix. The resulting matrix showed that field pea stands first followed by faba bean as their preference. Linseed, which was the most preferred cash crop by Bilo farmers, became the third followed by tef by Nanno-Jidu farmers. This is because faba bean is highly affected by diseases in Bilo. Here, there is a need to develop/screen varieties performing well in both conditions to improve the income level of farmers in the district.

4.1.4. Land tenure and communal resources policies

Forest and grazing lands are communally owned resources. Management of these resources is perceived to be poor according to farmers. This is mainly due to public ownership. Cropland is increasing at the expense of these resources.

Perceptions of farmers were assessed through focussed group discussion on communal resources ownership. Farmer groups in relation to the advantages and disadvantages of privatization or nationalization raised issues. One of the groups supported privatization as an opportunity to improve management and utilization. The other groups supported nationalization (communal resources ownership policy) because it can alleviate the problems of labor hours spent on safeguarding one’s share, which is usually done by children. This gives a better chance for children to get schooling.

However, it was also reported that little or no care is given to communal resources such as pasturelands, forests, as well as rivers and streams. This is because of the growing demand for farmlands, construction, fuel, and marketing of wood and wood products as a result of the population explosion.

Information was also collected on the perception of farmers on land tenure policy, an issue discussed thoroughly among participants. They reported that land distribution was done some seven years ago, and no redistribution has been made since. The increase in family size and dependency of some of the married members on parents has brought about continuous land fragmentation. Similar to the communal resources ownership policy, some of the participants supported the positive aspects of the existing land tenure policy while others opposed it. Those who did not accept (14.3%) the land tenure policy reasoned that if one farmer can sell his/her land or buy land from oxen-less farmers, there could be a boost in production. The other group who supported the existing policy (85.7%) explained that if resource-poor farmers were allowed to sell their land, they would have no other choice but tenancy. They also reasoned that a boost in production brought only by the resource-rich farmers enhances polarity.
4.1.5. Farm typology

The team developed a typology of farm households from the data collected during PRA. The DAs of stations in the study sites also developed other typologies. These typologies were then compared with those developed by farmers. Wealth ranking, within an ecological zone, was done with farmers and other key informants. Variability among different categories of resource-rich, medium and poor, included the following four criteria:

- oxen ownership;
- total farm produce;
- number of cattle and equines; and
- size of farmland.

On the basis of these criteria the following household typologies were identified.

1. Resource-rich farm households

This type of farm household has a larger farm size (> 4 ha), enough farm oxen (>3), a large number of cattle (>10), equines (> 5) and a relatively high total farm produce (Table 4.3). They have large plots of homestead and distant farmlands. The accessibility to technological packages and extension services is better because they have the capacity to repay the credit, and meet the requirement of the Input Collection Unit (ICU) that no additional input (e.g. fertilizers) is extended if the past year’s credit has not been paid. They are also more risk averse.

Table 4.3. Farm typology of Tikur Inchini based on criteria of key informants and farmers for wealth ranking, 1999.

<table>
<thead>
<tr>
<th>Criteria/farm typology</th>
<th>Resource-rich farmers</th>
<th>Medium farmers</th>
<th>Resource-poor farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxen ownership</td>
<td>&gt; 3</td>
<td>1-2</td>
<td>0 or 1</td>
</tr>
<tr>
<td>Farm size</td>
<td>&gt; 4 ha</td>
<td>2-4 ha</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>Total farm produce</td>
<td>High</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Number of cattle</td>
<td>&gt; 10</td>
<td>3-10</td>
<td>&lt; 3</td>
</tr>
<tr>
<td>Number of equines</td>
<td>&gt; 5</td>
<td>2-4</td>
<td>0 or 1</td>
</tr>
</tbody>
</table>

2. Medium farm households

Medium resource farm households do not have enough farmlands (2-4 ha) and oxen (1-2), compared to resource-rich farmers. This type represents the majority of farmers in Tikur Inchini. They have small homestead plots whereas distant plots are not so large as to grow a diversity of crops for their family. This is due to the fact that they do not have enough oxen and/or have little or no capacity to use agricultural inputs like fertilizers. Access to package technologies is limited because either they may not meet the criteria set by the ICU or they do not take risks.

3. Resource-poor households

These households have few or no ox, farmlands (< 2 ha), cattle (< 3), maybe a few hen, and depend entirely on enset and cabbage for food. They cope with famine by selling their labor to rich farmers. The quality of enset produced by this group is poor because they use little or no manure. Despite their constraints, they are forced to pay tax for their farmlands, by renting or selling their pasture to livestock owners. The cash generated from this sale goes to the government in the form of tax or to the family in the form of consumables. Homesteads are prepared for planting by family labor. This group is always at risk. Promotion of investments by private or non-governmental organizations, which may create employment opportunities, is essential for their survival.
4.1.6. Trends of socioeconomic constraints

Socioeconomic factors change over time because of changes in society and the environment. Among them is the ever-increasing population that leads to continued fragmentation of farmlands. This has a direct relation to continuous cultivation, which in turn results in declining of soil fertility, low productivity of crops and food insecurity.

Table 4.4 shows the absence of family planning, continued polygamy, and lack of awareness of control measures leading to increasing family size year after year. This is the cause for worsening problems of land shortage, decreasing pasturelands, decreasing forest covers, and declining soil fertility.

On the other hand, construction of roads, schools and clinics showed a gradual increasing trend over the past three to one decade. This is because of the changing policy of successive governments. Other support services like extension also showed an improving trend over the last decade due to the shift in agricultural development policies.

However, resources like rivers and streams are under-utilized due to the lack of private or public investments. Development of irrigation schemes for the production of potato, onion/garlic, barley, and other cash crops can bring development in accordance with the aim of food self-sufficiency set by the government. Participatory R & D is a means to achieve this goal. Policy makers should encourage involvement of private investors in development activities.

Table 4.4. Summary of historical trends of major components of the farming systems of Tikur Inchini district.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Trend</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family size</td>
<td>Increasing rapidly</td>
<td>Absence of family planning due to lack of awareness or access to control measures, polygamy</td>
</tr>
<tr>
<td>Farmland size</td>
<td>Decreasing rapidly</td>
<td>Fragmentation of land among family member upon marriage</td>
</tr>
<tr>
<td>Pastureland size</td>
<td>Decreasing rapidly</td>
<td>More demand for cropland, due to increasing population, absence of land use policy</td>
</tr>
<tr>
<td>Forest cover</td>
<td>Decreasing</td>
<td>More demand for fuel, construction, farmland, cash generation by selling coal, fuel wood due to rapid population growth, poor responsibility for communal resources</td>
</tr>
<tr>
<td>Rivers and streams</td>
<td>Decreasing</td>
<td>Declining forests, climate changes leading to poor rainfall amount and distribution</td>
</tr>
<tr>
<td>Soil fertility</td>
<td>Declining</td>
<td>Continuous cultivation, absence of fallow system due to decreasing farm size as population increases</td>
</tr>
<tr>
<td>Infra-structure</td>
<td>Gradually improving</td>
<td>Government and private investments</td>
</tr>
</tbody>
</table>

21
4.2 Natural Resources

4.2.1. Soil

The soil resources existing in the study area are usually recognized by their color. This soil classification system which relies on the color of the top soil is entirely adopted both by the peasant farmers and district agricultural experts. According to the district agricultural office, two soil types are found in the area; these are black-brown and red soils as shown below in Fig. 4.2.

![Soil Classification Chart](source: District Agricultural Office)

Fig. 4.2 Major soil types in the Tikur Inchih district.

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Location</th>
<th>Fertility</th>
<th>Workability</th>
<th>Soil pest</th>
<th>Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black soil</td>
<td>Highland &amp; flat land forms</td>
<td>High N content</td>
<td>Easy in rooting</td>
<td>Severe</td>
<td>Barley, inset</td>
</tr>
<tr>
<td>Brown soil</td>
<td>Midland areas with gentle slopes</td>
<td>Needs NP</td>
<td>Difficult</td>
<td>Intermediate</td>
<td>Barley, wheat</td>
</tr>
<tr>
<td>Red soil</td>
<td>Low-lying &amp; well drained areas</td>
<td>Low</td>
<td>Intermediate</td>
<td>Low</td>
<td>Tef, wheat</td>
</tr>
</tbody>
</table>

Soil classification based on more reliable technical procedures certainly requires to understand the geomorphology, parent materials, soil forming factors, together with the prevalent climatic and environmental conditions, which are all dependent on conducting an extensive soil survey which is beyond the scope of this study. However, efforts were made to refer to previous studies in addition to making rapid field observations. Generally, based on the available information, the soil groups and associated soil units are presented as follows.

**Black soils**

Black soils cover a vast area in the district. The soils are developed under grass and forest vegetation. They are dark in color with brown to gray A horizon. They are soft with the top layer rich in organic matter. The fact that these soils have poor response to fertilizers could be associated with their rich organic matter contents. They are mainly found in flat and rolling landforms of highland areas (Table 4.5).

Generally, black soils are porous with good water holding capacity, well aerated with good natural fertility status. Normally, they make excellent farmlands. In the flat lands they are extensively used for cattle rearing and grazing. Black soils are prone to wind and water erosion. Moreover, they are severely infested by soil pests like moles and chaffer gophers. The pest problem in this area could be aggravated...
because of the porous nature of the soil and rich organic matter content, which is conducive to the pest development.

**Red and Brown soils**
The red and brown soils are mainly distributed on gentle slopes; mountain areas and locations, which are more, exposed to extensive surface drainage (Table 4.5). These soil groups have a brown and dark brown A-horizon overlying the grayish brown and red B-horizon. Soils in the gentle slopes are well drained, while gleyic properties could be induced in the bottomlands due to the rise in the water table. These soils have good physical properties and better moisture holding capacity. They are also known to have good mineral reserves and fertility. However, the calcified surface soils could have a low organic matter content and be slightly acid in reaction. In general they are fertile, and suitable for a wide range of agricultural uses, including arable lands, pasture lands and forest production.

4.2.2. **Forest**

**State of the existing natural vegetation**
The existing forest and vegetation cover in the study area is about 9.4% of the total area of the district. This is far higher than both the zonal and national forest coverage, which are in the order of 4% and 2.5%, respectively. In the district, high forestland, bush/shrub lands and woodlands take the major share of the forest area with area coverage of about 26%, 23% and 16%, respectively (Table 4.6).

Table 4.6. Vegetation type and its area coverage in the study area.

<table>
<thead>
<tr>
<th>Vegetation type</th>
<th>Area (ha)</th>
<th>Area coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High forest</td>
<td>1291</td>
<td>26</td>
</tr>
<tr>
<td>Wood land</td>
<td>807</td>
<td>16</td>
</tr>
<tr>
<td>Revere</td>
<td>585</td>
<td>12</td>
</tr>
<tr>
<td>Bush and shrubs</td>
<td>1129</td>
<td>23</td>
</tr>
<tr>
<td>Savanna</td>
<td>589</td>
<td>12</td>
</tr>
<tr>
<td>Others</td>
<td>598</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>5000</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Zonal Planning Bureau

**Spatial distribution**
Striking differences in the spatial distribution of forests have been observed in the study area. The vegetation and forest cover is high in and around homesteads, villages, mountain and highland areas. In contrast, the forest and vegetation cover in the midland areas; open fields and flat land areas are quite marginal, as they have been cleared for cultivation.

**Species composition**
Indigenous forest trees are found mainly in the mountainsides and hilly plateaus. Some remnants of local trees are still found inside farmlands and around villages. Bamboo tree, locally known as *shimelaa*, takes over 40% of the total forest area (Table 4.7). Other species like *Junipers*, *Olea*, and *Podocarpus* are almost entirely utilized for timber and other uses. Other local tree species in the area include *Erica* sp., *Arborea* sp., *Bersema* sp, and *Apodytes* sp., which are all at severe risks of being eliminated from the ecosystem. Among the exotic species *Eucalyptus*, *Cuprussus*, and *Acacia* are expanding rapidly in the private wood lots (Table 4.6).
Table 4.7 Indigenous forest tree species found in Tikur Inchini.

<table>
<thead>
<tr>
<th>Local name</th>
<th>Scientific name</th>
<th>Area coverage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heexoo</td>
<td>Hagenia abyssinica</td>
<td>7</td>
</tr>
<tr>
<td>Homii</td>
<td>Pygeum africana</td>
<td>4</td>
</tr>
<tr>
<td>Birbirsa</td>
<td>Podocarpus falcutus</td>
<td>5</td>
</tr>
<tr>
<td>Luggee</td>
<td>Schefflera volkensi</td>
<td>3</td>
</tr>
<tr>
<td>Mekantissa</td>
<td>Croton macrostachis</td>
<td>4</td>
</tr>
<tr>
<td>Gairta biya</td>
<td>Juniperous procera</td>
<td>15</td>
</tr>
<tr>
<td>Lafttoo</td>
<td>Accacia abyssinica</td>
<td>5</td>
</tr>
<tr>
<td>Wadessa</td>
<td>Cordia africana</td>
<td>5</td>
</tr>
<tr>
<td>Kombolcha</td>
<td>Maytenus senegalensis</td>
<td>4</td>
</tr>
<tr>
<td>Somboo</td>
<td>Ekebergia capensis</td>
<td>2</td>
</tr>
<tr>
<td>Shimelaa</td>
<td>Acindinaria alpina</td>
<td>41</td>
</tr>
</tbody>
</table>

Source: District Agricultural Office

Management
Since the far past, farmers did not give due emphasis to protect and develop forests. Rather they heavily depend on natural forests for timber, construction and fuel sources. Hence, farmers have destructive effects on forest resources, which were communally owned.

Cutting trees, ringing (debarking), exposing the roots to sun’s heat, defoliation and pruning and burning are the common means of forest destruction for the purpose of getting new farm lands, forest products and reducing the impact of wild animals and shade on crops. In the recent past, attempts have been made to establish private wood lots. Agricultural offices through seedling distribution support such efforts. Hence, farmers start to grow trees (exotic species) around their homesteads. They prepare a one meter deep hole locally known as “quota” around their homestead and plant trees inside the deep hole using very dense spacing. The hole is used to protect from frost, animal and wild life damages on the tree seedlings. Although quota is labor demanding it is a promising indigenous tree growing practice, which could be adopted by farmers in other areas too.

Constraints
The major development constraints in the forestry development sector are:
- absence of land-use system;
- lack of conservation and management plan on both state and community forests;
- lack of land tenure security;
- poor management skills on forest development;
- frost damage on newly established seedlings; and
- shortage of fuel wood and alternative energy sources.

Trends
In the past, both the vegetation and forest cover in this district were quite rich and dense. However, the forest cover in the area has declined substantially through time.

Table 4.8. System trends in forest development of Tikur Inchini.

<table>
<thead>
<tr>
<th>System</th>
<th>Trends</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total forest area</td>
<td>Declining</td>
<td>Deforestation</td>
</tr>
<tr>
<td>Indigenous tree species</td>
<td>Diminishing</td>
<td>Deforestation and no reforestation made</td>
</tr>
<tr>
<td>Communal forest</td>
<td>Declining</td>
<td>No strong control system</td>
</tr>
<tr>
<td>Private wood-lot</td>
<td>Increasing</td>
<td>Growing demand for timer, fuel</td>
</tr>
<tr>
<td>Exotic species</td>
<td>Increasing</td>
<td>Seedling supply of fast growing sp</td>
</tr>
<tr>
<td>Farmers awareness</td>
<td>Increasing</td>
<td>Start to establish wood lots</td>
</tr>
<tr>
<td>Area expansion in midlands</td>
<td>Increasing</td>
<td>Growing needs for forest products</td>
</tr>
</tbody>
</table>
Farmers are involved in planting trees in their vicinity for the purpose of not only getting forest products for their own needs, but also for the purpose of land security, to reduce the influence of frost damage and for selling forest products in the near by markets. Shortage of land has forced them to grow forest seedlings in very dense spacing. In some locations, there is a growing trend of planting eucalyptus trees on farmlands. Although the net economic return is a decisive factor for land utilization, forest development needs to be linked and integrated with improved land use management in the future.

4.2.3 Water Resources

The district is well endowed with rich hydrological potential (Table 4.9) made possibly by its above-average rains for extended periods (see 3.2.2). As the study area is located within the Blue Nile river basin system, its surface water eventually drains towards the Abay river basin.

Table 4.9. Perennial rivers found in the Tikur Inchini district

<table>
<thead>
<tr>
<th>Perennial river</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balo</td>
<td>25</td>
</tr>
<tr>
<td>Tikur</td>
<td>23</td>
</tr>
<tr>
<td>Iyasu</td>
<td>15</td>
</tr>
<tr>
<td>Abayi</td>
<td>10</td>
</tr>
<tr>
<td>Kato</td>
<td>9</td>
</tr>
<tr>
<td>Hine</td>
<td>8</td>
</tr>
<tr>
<td>Jara</td>
<td>8</td>
</tr>
<tr>
<td>Hari</td>
<td>7</td>
</tr>
<tr>
<td>Hane</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Zonal Planning Bureau

Moreover, several seasonal rivers, streams, ponds including vast under ground water sources exist in the district. Major Streams found in the study area are Abayaud, Chancho and Huoo. Major Springs found in the study area include Zeude, Yahi, Kurie, and Kumetie. These water resources are used mainly for drinking, sanitation and for livestock. Springs are the major sources of water for drinking purpose. Whenever springs dry and/or when they are not available in a certain area, people depend on rivers for drinking and cleaning. As far as the importance of water sources is concerned, springs, rivers and wells contribute 70, 25 and 5%, respectively of the water used for drinking and cleaning according to the Zonal Planning Bureau.

Although the study area is rich in ground water, no effort has been made so far to utilize it more effectively. The great majority of the people in the area do not get potable water. Only the people in the district town have access to tap water services, since last year.

Constraints of water resources

- poor water management practices;
- shortage of water in the mountain areas;
- lack of water use policy;
- distant location of water resources;
- lack of clean, disease free, potable water;
- difficulty to utilize river water for surface irrigation (need pump); and
- little effort has been made to utilize water wells.

System Trends

Based on the farmers' viewpoints, the main system trends of water resources are:

- the volume of perennial rivers is decreasing;

- shortage of water in the mountain areas;
- distant location of water resources;
utilization and demand for streams and springs has risen;
- the flow of streams and springs is declining; and
- the number of seasonal rivers is decreasing.

4.2.4 Wild Life

Existing situation
Currently there are several types of wild life species in the study area. Some of the common ones are: spotted hyena, monkey, several bird species, porcupine, rabbit, common jackal, civet cat, wild pig (bush pig), antelope, and bush buck.

At the present time there are no parks, game reserves or sanctuaries in the district. Virtually no effort has been made so far to protect and conserve the wild life resources in the study area. In fact, the existence and continuity of these resources are simply lost for nature, certainly with adverse effects due to human interference.

System trends and perception of farmers
The system trend indicates that there is a declining trend in the wild life resource base of the study area, mainly because of the collective impacts of human activities and other related factors, as summarized below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Trend</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human interference</td>
<td>Increasing</td>
<td>Farming</td>
</tr>
<tr>
<td>Hunting</td>
<td>Decreasing</td>
<td>Income, leisure</td>
</tr>
<tr>
<td>Ecological disturbance</td>
<td>Decreasing</td>
<td>Deforestation, Forest fire, settlement</td>
</tr>
<tr>
<td>Food for wildlife</td>
<td>Decreasing</td>
<td>Change in ecosystem</td>
</tr>
<tr>
<td>Species number</td>
<td>Decreasing</td>
<td>Human interference</td>
</tr>
<tr>
<td>Species composition</td>
<td>Decreasing</td>
<td>Human interference</td>
</tr>
</tbody>
</table>

Source: FAO study, 1999

Constraints
The major constraints known as far as wild life resources are concerned are:
- lack of wild life protection, conservation and utilization;
- heavy human interference on their habitat;
- bird attacks on crops; and
- pigs, porcupine attacks cultivated crops.

In view of the fact that the area has good climatic and ecological conditions, there is a quite substantial opportunity to develop and utilize the wildlife resources in the area and eventually promote the tourism industry.
4.3. **Crop production**

People of Tikur Inchini depend on a mixed farming system composed of crop and livestock production. Farmers save crop residue for feed, use manure for crop production, and use animals for cultivation threshing and transport.

The Planning Office of Agricultural Development at Ambo (1998) reported that the total area of Tikur Inchini district is about 53,810 ha. The area covered by crops, grazing land, vegetation and others are given in Table 4.11.

Table 4.11 Land use pattern of the district for the year 1996/7 and 1997/8.

<table>
<thead>
<tr>
<th>Description</th>
<th>1996/7</th>
<th>1997/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996/7</td>
<td>('000ha)</td>
<td>%</td>
</tr>
<tr>
<td>Land under crops</td>
<td>9.38</td>
<td>21.41</td>
</tr>
<tr>
<td>Land under annual crops</td>
<td>7.51</td>
<td>80.06</td>
</tr>
<tr>
<td>Land under perennial crops</td>
<td>1.87</td>
<td>19.94</td>
</tr>
<tr>
<td>Grazing land</td>
<td>26.76</td>
<td>49.73</td>
</tr>
<tr>
<td>Land covered by vegetation</td>
<td>3.21</td>
<td>5.97</td>
</tr>
<tr>
<td>Cultivated land (potential)</td>
<td>8.03</td>
<td>14.92</td>
</tr>
<tr>
<td>Swampy and marshy land</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Degraded land</td>
<td>2.02</td>
<td>3.75</td>
</tr>
<tr>
<td>Land used for other purposes</td>
<td>4.41</td>
<td>8.20</td>
</tr>
<tr>
<td>Total area of the district</td>
<td>43.81</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: - Planning Office of Agricultural Development for Tikur Inchini district

As indicated in Table 4.11, the total area covered by annual crops in 1996/7 and 1997/8 was 80.06% and 85.41%, respectively, of the total land under crops in the district, suggesting expansion of farmland allocated for annual crops.

The major crops grown in the district are barley, wheat, tef, maize, enset, linseed and Ethiopian gomenzer (*Brassica carinata*). Although rain-fed crop cultivation is the principal activity of the farming system, *belg* season production is not practiced in the district except for potato that often grows from February to June. As shown in Table 4.12, barely by occupying (5,740 ha) ranks first followed by wheat (2,240 ha), tef (870 ha) and maize (160 ha) in terms of area coverage in 1997/98.
Table 4.12. Estimated area and production of the major crops grown in Tikur Inchini district in 1996-98.

<table>
<thead>
<tr>
<th>Type of crops</th>
<th>1996/7</th>
<th>Production</th>
<th></th>
<th>1997/8</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>('000 ha)</td>
<td>%</td>
<td>('000 ha)</td>
<td>%</td>
<td>('000 ha)</td>
</tr>
<tr>
<td>Cereals</td>
<td>5.85 (77.9)</td>
<td>1.63 (62.2)</td>
<td>9.06 (79)</td>
<td>97.25</td>
<td></td>
</tr>
<tr>
<td>Tef</td>
<td>0.41 (5.5)</td>
<td>2.61</td>
<td>0.87 (7.6)</td>
<td>6.27</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>0.94 (12.5)</td>
<td>1.46 (4.3)</td>
<td>2.24 (19.5)</td>
<td>24.44</td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>4.45 (59.3)</td>
<td>6.01 (17.0)</td>
<td>574 (30)</td>
<td>6427</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>0.05 (0.7)</td>
<td>3.11 (18.7)</td>
<td>0.16 (1.4)</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>Sorghum</td>
<td>-</td>
<td>-</td>
<td>0.05 (0.4)</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Pulses</td>
<td>0.48 (6.4)</td>
<td>0.73</td>
<td>0.65 (5.7)</td>
<td>3.42</td>
<td></td>
</tr>
<tr>
<td>Field peas</td>
<td>0.17 (2.3)</td>
<td>0.79</td>
<td>0.23 (2)</td>
<td>0.93</td>
<td></td>
</tr>
<tr>
<td>Paba-beans</td>
<td>0.31 (4.2)</td>
<td>1.84</td>
<td>0.41 (3.6)</td>
<td>2.47</td>
<td></td>
</tr>
<tr>
<td>Lentils</td>
<td>-</td>
<td>-</td>
<td>0.01 (0.09)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Oil crops</td>
<td>1.18 (15.7)</td>
<td>0.47 (2)</td>
<td>1.78 (15.3)</td>
<td>7.70</td>
<td></td>
</tr>
<tr>
<td>Nouj</td>
<td>-</td>
<td>-</td>
<td>0.05 (0.4)</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Linseed</td>
<td>0.67 (8.9)</td>
<td>2.59</td>
<td>1.00 (8.7)</td>
<td>3.98</td>
<td></td>
</tr>
<tr>
<td>Gomenzer</td>
<td>0.51 (6.8)</td>
<td>2.02</td>
<td>0.71 (6.2)</td>
<td>3.57</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7.51</td>
<td>70.87</td>
<td>11.47</td>
<td>108.37</td>
<td></td>
</tr>
</tbody>
</table>

Source: Office of Planning and Economic Development for West Shoa Zone.

4.3.1 Crops and cropping practices

As indicated in Table 4.12, Tikur Inchini district is suitable for the cultivation of a range of annual crops. Among the annual crops grown in 1996/7, cereal crops covered most of the land, barley occupying 59% of the area. However, the total area coverage of barley in 1997/8 was reduced by 9% while farmlands allocated for tef, wheat and maize increased (Table 4.12). Yield reduction due to frost, chaffer grub infestation, high input cost and low price of grains affected farmers' attitudes towards barley cultivation. In the district, barley is primarily grown for food but may also be sold for cash.

Enset is the principal perennial crop cultivated in Tikur Inchini. In 1997/8, enset occupied 14.59% of the total land under crops. Enset serves as a staple food supplemented with barley, maize and milk products. The role of enset in the farming system is discussed in section 4.3.3.

Two major rivers cross Tikur Inchini district. However, since they are found in lower levels of the ground, and pumps are required to supply water, they have never been utilized for irrigation. This has limited the production of vegetables in the district.

In Tikur Inchini, fragmented land, crop pests, declining soil fertility and frost pose a threat to crop production. To cope with these challenges, farmers have devised a number of strategies including selecting crops and varieties appropriate for the area. As shown in Table 4.13, farmers grow a wide range of varieties to avoid risks as well as to meet the different household requirements. Due to limited seed distribution of improved varieties, most farmers in the district use land races to a larger extent. Below listed are the major crop varieties and their characters as described by farmers.
<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>HB-42</td>
<td>Improved variety introduced in 1995, matures late, high yielder, has high demand in the market</td>
</tr>
<tr>
<td></td>
<td>Local black seeded</td>
<td>Used for local beer and malt has high price, late maturing, pest susceptible.</td>
</tr>
<tr>
<td></td>
<td>Turbucha (black and white seeded)</td>
<td>Used for beer and malt, high yielder in flour.</td>
</tr>
<tr>
<td></td>
<td>Abiyot</td>
<td>Used for Injera and kolo, high flour yielder.</td>
</tr>
<tr>
<td></td>
<td>Degu</td>
<td>Requires fertile land, white seeded and appreciated by people.</td>
</tr>
<tr>
<td></td>
<td>Local white seeded</td>
<td>Used for Injera, beso and fetches high price, late maturing, and pest susceptible.</td>
</tr>
<tr>
<td></td>
<td>Malt barley (two rowed)</td>
<td>Requires fertile land, flour yield is lower.</td>
</tr>
<tr>
<td></td>
<td>Semereta</td>
<td>Early maturing, low yielder</td>
</tr>
<tr>
<td>Wheat</td>
<td>Dashen</td>
<td>Used for Injera, bread and kolo, and gives better yield than ET-13-A2</td>
</tr>
<tr>
<td></td>
<td>ET-13-A2</td>
<td>First introduced in 1994/95. White seeded, used for Injera, bread and kolo, yields 20 to 30q/ha. It takes 135 to 150 days for maturity.</td>
</tr>
<tr>
<td></td>
<td>HAR-710:</td>
<td>Introduced in 1997/98, it is white seeded that takes 130 days for maturity, yields 16 to 22 q/ha. It is susceptible to septoria and rust diseases. This year, it is out of production.</td>
</tr>
<tr>
<td></td>
<td>HAR-1685</td>
<td>First introduced in 1997/98. It is white seeded that matures with in 130 to 135 days, and yields 16 to 24 q/ha. Susceptible to septoria, this year it is out of production.</td>
</tr>
<tr>
<td></td>
<td>Kenya</td>
<td>It is a bread wheat, gives similar yield as Dashen variety</td>
</tr>
<tr>
<td>Tef</td>
<td>DZ-01-354</td>
<td>First introduced in 1995/96. It is a low yielder and also susceptible to frost. Farmers do not demand this variety and hence the MoA abandoned its distribution.</td>
</tr>
<tr>
<td>Maize</td>
<td>Oromo maize (local)</td>
<td>Late maturing, affected by logging and low yielder.</td>
</tr>
<tr>
<td></td>
<td>BH-660</td>
<td>First introduced in a 2 ha demonstration site and now it is planted in more than 20 ha of land. It gives 45 to 60 q/ha. It is planted in April and harvested in December or January. It is least affected with pest and diseases.</td>
</tr>
<tr>
<td>Linseed</td>
<td>CI-1525</td>
<td>It was introduced in 1996/97. It is planted in June and harvested in November, and yields about 6 q/ha. Less affected with pests.</td>
</tr>
<tr>
<td></td>
<td>Chilalo</td>
<td>It was introduced in 1996/97 and its yield is better than CI-125 (8 q/ha). Less affected with pests.</td>
</tr>
<tr>
<td></td>
<td>Red linseed (Local)</td>
<td>It is low yielder (4 q/ha). It is planted in June and harvested in November.</td>
</tr>
</tbody>
</table>
Table 4.13 Cont’d.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Variety</th>
<th>Merits/Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faba bean</td>
<td>CS-20 DK</td>
<td>Introduced in 1996/97 in 2.5 ha of land. It is planted in June and harvested in November, yields about 10 q/ha.</td>
</tr>
<tr>
<td></td>
<td>Local</td>
<td>It is planted in June and harvested in November, yields about 4 to 5 q/ha. It is susceptible to aphids and other insect pests.</td>
</tr>
<tr>
<td>Ethiopian gomezer</td>
<td>Local</td>
<td>It is planted in June and harvested in December, yields about 5 q/ha. It is susceptible to aphids and other leaf diseases.</td>
</tr>
<tr>
<td></td>
<td>Yellow Dodola</td>
<td>On-farm trials from 1995 to 1997. Farmers are not satisfied with it, as application of high rate of fertilizer is required to give good yield.</td>
</tr>
<tr>
<td></td>
<td>Tolcha</td>
<td>On-farm trial since its introduction in 1996/97, Yields range from 60 to 70 q/ha. It is tolerant to late blight. It is planted in June and harvested in November.</td>
</tr>
<tr>
<td></td>
<td>Hakim (Local)</td>
<td>It is susceptible to late blight. Planted in August and harvested in January. Yields about 40 q/ha. Planted once a year.</td>
</tr>
<tr>
<td></td>
<td>Awashe (Improved)</td>
<td>Moderately resistant to late blight. It is high yielder.</td>
</tr>
<tr>
<td></td>
<td>Genet</td>
<td>It is high yielder, and tolerant to red ant damage.</td>
</tr>
<tr>
<td>Potato</td>
<td>White flower</td>
<td>Cooked potato has good taste, planted once a year. Susceptible to pest damage, but has good yield.</td>
</tr>
<tr>
<td></td>
<td>Red flower</td>
<td>Used for wheat, planted twice within a year. Susceptible to pest damage.</td>
</tr>
<tr>
<td>Enset</td>
<td>Badedeti</td>
<td>Relatively tolerant to wilt, yield of bula is high and is preferred for food, the fiber is strong, late maturing (3-5 years after the third transplanting) depending on soil type and altitude, the plant is grey in color and is best favored by farmers.</td>
</tr>
<tr>
<td></td>
<td>Sebarawi</td>
<td>Black colored plant, has big tasty amicho, the fermenting process is fast, tolerant to wilt similar to Badedeti.</td>
</tr>
<tr>
<td></td>
<td>Feresiye</td>
<td>Susceptible to wilt, early maturing (2-3 years) high yielder and has big amicho, the plant is reddish in appearance.</td>
</tr>
<tr>
<td></td>
<td>Awogna</td>
<td>Grows faster than Feresiye, it is susceptible to wilt.</td>
</tr>
<tr>
<td></td>
<td>Shertiye</td>
<td>Same as Feresiye, has sweet amicho, grey in color, and tolerant to wilt.</td>
</tr>
<tr>
<td></td>
<td>Ashakiti</td>
<td>Black in color, susceptible to wilt, has watery paste and good fermenting ability, it is the least appreciated by the farmers.</td>
</tr>
<tr>
<td></td>
<td>Garda</td>
<td>Amicho or worke are good, early maturing, fast fermenting and white colored kocho, it is susceptible to wilt.</td>
</tr>
<tr>
<td></td>
<td>Aba-jobir</td>
<td>Red leafed as Feresiye, tolerant to wilt.</td>
</tr>
<tr>
<td></td>
<td>Achoore</td>
<td>Late maturing, has a tasty amicho.</td>
</tr>
</tbody>
</table>

Crop preference
Almost all farmers in Tikur Inchini grow barley among other crops. However, results of pair-wise ranking (Table 4.14) showed that crop preference of farmers both in the highlands and midlands is enset (Ensete ventricosum), which is a giant herbaceous plant related to banana that provides food throughout the year. Enset is a typical multipurpose crop and its every part is thoroughly utilized. The corms, pseudostems and leaf stems are used as a source of food. Kocho or woke is carbohydrate rich fermented food made from corm and pseudostem of older plants. The period of fermentation varies from two to three months or even more depending on the variety and processing practices. The cut-leaves are important for wrapping, thatching, sheeting for sitting, making containers, shading humans from sun’s heat and also protecting them from rain. The pseudostem also yields strong fibers for tying livestock and bundling harvests from the field. It is also a good fiber crop that generates income to the household. Most parts of the enset plant are also good fodder source for the livestock. Details on the role of enset are provided in section 4.3.4.
Table 4.14 Pair-wise ranking of crop/varietv preference at Kotiye-Gadi village (highland).

<table>
<thead>
<tr>
<th></th>
<th>Enset 42</th>
<th>Barley HB 42</th>
<th>Barley local HB 42</th>
<th>Linseed CI-1525 local</th>
<th>Potato improved</th>
<th>Potato local</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enset</td>
<td>Enset</td>
<td>Enset</td>
<td>Enset</td>
<td>Enset</td>
<td>Enset</td>
<td>Enset</td>
</tr>
<tr>
<td>Barley HB 42</td>
<td>Barley HB 42</td>
<td>Barley HB 42</td>
<td>Potato improved</td>
<td>Potato improved</td>
<td>Barley HB 42</td>
<td>Barley HB 42</td>
</tr>
<tr>
<td>Barley local</td>
<td>Linseed CI-1525</td>
<td>Linseed local</td>
<td>Linseed CI-1525</td>
<td>Linseed CI-1525 local</td>
<td>Potato improved</td>
<td>Linseed CI-1525</td>
</tr>
<tr>
<td>Linseed CI-1525</td>
<td>Linseed local</td>
<td>Linseed CI-1525</td>
<td>Potato improved</td>
<td>Linseed CI-1525 local</td>
<td>Potato improved</td>
<td>Linseed CI-1525</td>
</tr>
<tr>
<td>Potato improved</td>
<td>Potato local</td>
<td>Potato improved</td>
<td>Potato improved</td>
<td>Potato improved</td>
<td>Potato Improved</td>
<td>Potato Improved</td>
</tr>
<tr>
<td>Potato local</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tef is the second most preferred crop in the midland villages for its market value. It has less insect pests and matures before the onset of frost in November. Whereas potato improved varieties (Awash and Genet) are the second choices in the highlands. The improved potato varieties are high yielding and short-cycled, and can escape frost. Moreover, they have high market value, which has encouraged expansion of its production. In the midlands, however, access to improved potato seeds is minimal and hence farmers cultivate local varieties in small scale.

Improved barley variety HB 42 is only the third most preferred crop despite its large area coverage. It provides an average yield of 12 q/ha and the farmers use it as a food source and means of income generation. The local land races, however, are low yielders and less appreciated. Three local land races of barley are widely cultivated in the village. The white seeded barley is preferred to the black seeded one despite their comparable yield (8 q/ha). The latter is as appreciated as the improved wheat variety ET 13 that gives an average yield of 16 q/ha. Similarly, the local barley *Semereta* and the wheat *Dashen* varieties, with an average yield of 4 q/ha and 8 q/ha, respectively, have a comparable importance in the area.

Maize is also cultivated in the homestead fields. Because of the cold temperature of the area, it usually takes about eight months to harvest. The improved variety BH 660 has good yield (45-60 q/ha) at Kotiye-Gadi village. The good yield and market potential has enhanced farmers’ repayment capacity in addition to providing a source of food. But the local maize varieties are low yielders (12-15 q/ha) and are less preferred by the farmers.

Both improved and local varieties of linseed are cultivated in the district. However, improved linseed variety is not widely available in the midland villages. The improved linseed variety is known for its high yield and market value. In addition, it has a short cycle that enables the variety to mature before the beginning of frost.

In general, farmers’ perception and interest towards the improved varieties is high for it provides high yield and is relatively resistant to pests and diseases. Moreover, farmers appreciate the ability of short-cycled varieties to escape frost. However, the high cost of inputs has created difficulty for effective utilization of the improved seed varieties.
From Table 4.14, it is clear that enset is the most preferred crop followed by the improved potato varieties (Awash and Genet), barley (HB-42), linseed (CI-1528) and local varieties of linseed, barley and potato.

**Crop calendar**

Tikur Inchini district receives bimodal rainfall: the short rains, *belg*, come between February and April and the long rains, *meher*, come between June and September. Moisture stress in May together with problems of sprouting at maturity prohibits production of crops in the *belg* season. The district is characterized by cool temperature that extends the crop maturity period. Consequently, if crops are planted in *belg*, harvesting coincides with the on-set of the main rainy season, resulting in sprouting. Hence, farmers are not accustomed to cultivate crops other than potato during *belg*. Although *belg* is not widely used for crop production, it enables re-growth of grasses that is essential feed source for livestock, and allows timely land preparation for the main season.

According to Chilot *et al.* (1998) early and late barley production systems exist in Tikur Inchini. The former bases early planting of early maturing varieties such as *Semereta* that require 3.5 to 4 months to mature. Early maturing barley cultivars are planted from mid-May to June and harvested between early September and early October. Chilot *et al.* (1998) indicated that early barley production is useful under poor soil conditions and where frost is a threat to production. The late barley production system takes place in the *meher* season, and planting is usually done between July and August. In places where chaffer grub incidence is high, late planting reduces the pest infestation.

<table>
<thead>
<tr>
<th>Crop type</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>HHTT</td>
<td>TT</td>
<td>LLLL</td>
<td>LLP</td>
<td>PPPP</td>
<td>WWWW</td>
<td>HH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>HHTT</td>
<td>TT</td>
<td>LLLL</td>
<td>LLP</td>
<td>PPPP</td>
<td>WWWW</td>
<td>HH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>TTTT</td>
<td>LLLL</td>
<td>PPPP</td>
<td>WWWW</td>
<td>HH</td>
<td>HH</td>
<td>HH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tef</td>
<td>H</td>
<td>H</td>
<td>LLLL</td>
<td>PPPP</td>
<td>WWWW</td>
<td>HH</td>
<td>HH</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Enset</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
</tr>
<tr>
<td>Potato</td>
<td>LLLL</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
</tr>
<tr>
<td>Gomenzer</td>
<td>TTTT</td>
<td>LLLL</td>
<td>PPPP</td>
<td>WWWW</td>
<td>HH</td>
<td>HH</td>
<td>HH</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field pea</td>
<td>TTTT</td>
<td>LLLL</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
<td>PPPP</td>
</tr>
<tr>
<td>Busiest period</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
<td>XXXX</td>
</tr>
</tbody>
</table>

$L = $Land preparation; $P = $Planting; $W = $Weeding; $H = $Harvesting; $T = $Threshing

Table 4.15 presents the timing of principal farm activities and shows that there is considerable overlapping. There is competition for labor between barley and wheat land preparation, planting, weeding, harvesting and threshing. Land preparation of barley and wheat overlaps with planting of potato. Similarly, land preparation of maize overlaps with threshing of barley, wheat, *gomenzer* and field pea. Planting of barley and wheat compete with weeding of maize. Planting of barley, wheat, tef, linseed, *gomenzer* and field pea also overlap. Maize planting and weeding competes with threshing and planting of tef, respectively. During harvest, maize competes with linseed and field pea. In short, all these competition of labor among enterprises create uneven management of crops. Therefore, options should be sought on labor saving technologies.
**Land preparation**

Oxen plough is the principal means of land preparation. *Maresha* is the implement used for ploughing. Time and frequency of land preparation varies depending on the type of crop, oxen availability and onset of rainfall. For all major crops, land preparation commences with the onset of rainfall mostly in April. For instance, land preparation for barley and wheat is between mid-April and early June after the first rain, whereas for maize and potato it begins during the dry season in February and March, respectively (Table 4.15).

Ploughing is made two to three times in Tikur Inchini, depending on the type of preceding crop. Annually fallowed lands and fields cropped with tef in the previous season are ploughed more intensively than fields cropped with other precursors. Ploughing of such fields is done in May immediately after the first rain while for fields with precursor crops other than tef is done during mid to end of June after the soil has received enough moisture. In most cases, tef fields are ploughed more frequently (3–4 times) than other crops, since the crop is small seeded and requires a fine seedbed. However, most farmers do not favor high frequency (more than twice) of tillage, as they believe it increases nutrient leaching and free movement of chaffer grubs.

**Planting**

The usual method of planting practice in Tikur Inchini is broadcasting of the seeds by hand. Row planting is considered tedious because of shortage of manpower and time.

Planting of barley and wheat takes place between early July and mid-August after the first heavy rains. In fields with severe chaffer grub infestation, farmers delay planting of some of the early maturing varieties so that the insect dies by suffocation caused by heavy rains. In addition, farmers plant barley on unpulverized, coarse and weedy seedbed to discourage the movement and multiplication of chaffer grub. Some farmers also practice early season barley production. The seed rate varies between 75 and 175 kg/ha, depending on fertility of the soil and time of planting (Chilot and Elias, 1998). Fewer seed rates are used usually when the crop is planted lately or the soil is fertile.

Maize planting is done in March when there is little moisture in the soil by manual broadcasting. Tef sowing takes place between late June and end of July. Tef needs to be planted on rainy days for effective seedbed preparation. This enables to reduce weed infestation and is done by trembling of animals on the ploughed fields. Tef planting frequently coincides with that of maize weeding (Table 4.15). Enset, potato and maize are planted on manured land that is usually situated near the homesteads. Enset plantation takes place between early November and late April while harvesting is done throughout the year.

**Weeding**

The major weeds in Tikur Inchini area are *Snowdenia* spp., locally called *muja*, *Bidens* spp. and a broad-leaved weed, which appeared to be *Polygonum* spp. (locally called as *dimu*). Hand weeding is the principal means of controlling weeds in the area. However, most of the farmers do not consider weeds as problematic and hence weeding is done less frequently. The other constraint mentioned for inadequate weeding is shortage of labor as weeding of many crops overlaps. Weeding of barley and wheat is done between late August and late September. Most farmers give priority to hand weeding of tef, which takes place between early September and October. Chilot and Elias (1998) reported that few farmers (about 4%) in Tikur Inchini district use 2,4-D herbicide on barley fields.
Harvesting and threshing

Harvesting is done manually by using a sickle. Harvesting time varies depending on the date of planting of the crop and the variety. For instance, barley, wheat and tef are harvested from mid-December to mid-January while the early maturing barley variety, *Semereta* (usually planted in May), is harvested from the end of August to mid-September. The harvesting period for maize is between mid-November and mid-December. Usually, threshing follows immediately after harvesting. Depending on food availability, however, threshing may be delayed two to five weeks after harvesting. Threshing is done by driving oxen or horses over the harvested crop on a circular piece of land. Grains are separated from straws and dregs by blowing in the wind, using big wooden forks and spoons.

The crops are then stored in locally constructed grain structures called *go/era*. It is prepared by weaving flexible woods such as bamboo and sealing with dung. The *go/era* is raised a few centimeters above the ground to avoid termite infestation, and are situated near the homestead.

4.3.2 Crop rotation

Crop rotation is the practice of shifting the location of crops each season so that the same crop does not grow in the same place year after year. This technique helps manage soil fertility, soil-borne diseases and some soil pests.

Crop rotation is practiced in almost every part of the district. Farmers are aware of the importance of rotation in maintaining soil fertility. However, due to the prevailing agro-climatic condition, rotation is carried out with only a few crops mostly cereals after cereals. As *helg* production is not practiced, rotation takes place between years. The most common rotations are:

- Barley/tef/linseed at Nanno Jidoo PA and Gabette village (midlands)
- barley/tef/linseed/wheat at Nanno village (midlands)
- barley/fallow/barley at Ganu village (highlands with adequate land)
- Wheat/fallow/wheat
- Barley/barley at Ganu village (highlands where farmlands are small).

In most of the study area, however, fallowing is rarely practiced due to land scarcity. It appears that the criterion to determine the rotation sequence may be the nutrient demand of the crop. More nutrient-demanding crops such as barley come first, followed by less nutrient demanding crops like tef.

4.3.3. Barley cultivation and trends

Barley cultivation in Tikur Inchini dates back to several hundred years. It occupies the largest share among other crops grown in the district. Resource-poor farmers prefer it because it is a low-input crop requiring relatively low investment. The farmers have adopted several land races that can grow in marginal areas where soil fertility is low. Although the land races offer an earlier harvest, they are also low yielders, and hence are less attractive to farmers. Recently, an improved variety (*HB 42*) was introduced, and has shown high market value and good yield despite its high input requirement.
In the study area, barley contributes both as a source of food and means of income. Its grains can be used to prepare different types of dishes and beverages. Moreover, the straw is a good source of feed during the dry season when there is an acute shortage of fodder. The straw and stubs are also important for thatching roofs and bedding.

Since the last few decades, however, yield of barley has been decreasing mainly due to the declining soil fertility, frost and chaffer grub infestation. Hence, farmers’ reliance on barley production is decreasing while cultivation of enset, potato, maize and tef is increasing.

### 4.3.4. Enset cultivation and trends

Enset grows well in the midland and highland areas of Tikur Inchini. The plant requires several years to reach maturity although it can be harvested at any stage. Maturity is estimated to take three to nine years, depending on the type of cultivar, soil condition, altitude, rainfall, amount of manure, etc. (Westphal (1975) cited in Taye, 1996). Due to food scarcity, labor shortages and annual ceremonies, however, most farmers tend to harvest enset before the plant has fully matured. Nevertheless, it is usually harvested in Tikur Inchini between five to seven years. Because enset can withstand prolonged periods of drought and can be harvested at any stage it enables farmers to stand against periods of food shortage. Year round cultivation of enset together with cereals and livestock constitute the farming system of Tikur Inchini. It appears that enset holds the system together and gives it a resilience feature.

In Tikur Inchini district, enset is the main staple crop that dominates the farming system. As considerations of food security determine cropping strategy, it is the number of enset plants available and their stages of maturity that can assist to determine a household’s decision regarding crop diversification and crop mix in each particular season. Accordingly, the cropping strategy of the area takes into account both long and short-term considerations as enset attains maturity between five to seven years.

Studies carried out to determine the yield of enset as *kocho* showed that the fresh weight from a mature enset plant ranges from 8 kg to 70 kg. According to Hiebsch (1996), the average yield is about 30 kg per plant and at an average plant spacing of 2.5 x 2.5 m (6.25 m² per plant and 1600 plants per ha), average yield of *kocho* is estimated to be 49 t/ha.

The storage period of *kocho* varies from several weeks to several months, or even several years, depending on the economic status of the household and its access to alternative food sources. The more well to do the family is the more enset food it has stored in underground pits, and the more the household is food secured. In summary, enset is a dependable food source and is expanding in area coverage in Tikur Inchini.
As an integral part of the farming system livestock plays an important role in the livelihood of Tikur Inchini district. There is a large livestock population, which serves important economic as well as social functions of the district. It provides draught power, milk, meat, egg, transport, manure, hides and skins and other products. Animals also serve as living banks for many farmers in the study area. The livestock sector is closely linked to the social and cultural lives of many resource-poor farmers. It ensures varying degrees of farming and economic stability. It also provides a source of regular and easily available cash income. The contribution of livestock as compared to its huge number is, however, very low. This is due to several factors, among which insufficient feed and high incidence of diseases are the most important ones.

The great majority of the livestock population is of indigenous breeds selected naturally over time for survival and adaptability to the ecological conditions of the area. According to farmers' perceptions and observations made in the study area there is homogeneity of cattle breed, all are humped zebu-types. The smallholder keeps his cattle in a traditional farming system where poor nutrition supply, poor management and high disease incidence prevail. The productivity in terms of milk, meat, eggs is low for all species. There are a limited number of crossbred cattle in Bilo-Abayi PA, which were introduced to the area by farmers' cooperatives a decade ago. Crossbred oxen have more plowing capacity compared to local ones. The following box contains a direct speech of a farmer emphasizing the draft power of crossbred oxen.

I have no crossbred oxen. But I know a farmer who has crossbred oxen. Everyday, he alternatively yokes two local oxen with one crossbred ox. One local ox is yoked only for half a day with a crossbred, which ploughs full day.

Sheep is reared for cash generation and sometimes for mutton during cultural holidays. Horses take the third place in livestock production at Tikur Inchini. Horses are reared mainly for transportation of humans and goods. They are also used as a source of cash income, manure and fuel, and prestige. In the mid-altitude areas, where tef is the major crop, horses provide draft power for crop threshing and soil compaction.

In Tikur Inchini, there is a large poultry population, which is used to meet the small cash needs of women and children. Local poultry types are common. An improved exotic breed, roede island, has been recently introduced to the area through the new extension services. The productivity of this exotic breed has been reported by the farmers to be very high, twice as much as local types. Women are traditionally responsible for poultry management. Poultry are normally let to scavenge with rare supplementation when there is enough grains, during crop harvesting and threshing. In most areas of the district, children begin to exercise private ownership of poultry with a hen given as a gift by their parents, relatives or using money they raised by themselves. Usually children sell their chicken during holidays, when they can get good prices. Then, they buy sheep to save their money in live banks, thereby raising their ownership status to the next higher stage. This process continues with the ownership growing from sheep to cattle, until the young boys get ready for marriage and establish independent life in the community. Thus, children are gradually trained how to manage livestock. In fact, this process may start with sheep or heifer depending on certain circumstances or wealth status of the children's family. Traditional bee keeping is also a common practice undertaken in combination with crop and livestock farming. There is no well-recorded data on the numbers, potential and productive capacity of the local beehives. However, according to the department of agriculture for West Showa Zone (unpublished data), there were 3800, 3610, and 3430 bee colonies in Tikur Inchini in 1996, 1997 and 1998 respectively. This accounted for 3.3% of the total bee colonies in the zone. Farmers reported that there were much more...
colonies in the past. Their number decreased because of deforestation and herbicides used on cropland. Honey is harvested in October and March when there are a lot of flowers. Honey harvested in October is produced from flowers of cereals, legumes and weeds. In March, however, honey is made from flowers of trees. Farmers also reported that the production per traditional beehive has declined by half. Major tree species used for production of honey in Tikur Inchini during dry season are those locally called *kombolcha, baar-gamoo, luqqee, anfara, heexoo, hiddafittii, qamaxxee and eebichaa* (see Chapter 4). These trees flower from March to April. According to farmers’ perception high honey quality and quantity is produced from flowers of *qamaxxee*. *Eebichaa (Vernonia amygdalina, tree)* and *hadaa* (*Guizotia scabra, weed*) also provide high quantity of honey production with less quality because of its high moisture content.

### 4.4.1 Livestock types and population

The livestock population of Tikur Inchini as compared with that of the West Shewa zone accounts for cattle about 2.9% (78,694), sheep 7.97% (49,160), horses 8.74% (13,841), poultry 5.34% (61,150), goats 3.8% (15,214), donkeys 0.6% (972) donkeys and mules 1.5% (432) as indicated in Fig. 4.4. The maximum numbers of cattle, sheep, poultry, and horse per household are 40, 10, 10, and 4, respectively, while the minimum holding for all species of livestock is one and sometimes nil.

![Population chart](image)

*Fig. 4.4 Population of livestock, poultry and bee-colonies in Tikur Inchini, 1998*

In addition to livestock and poultry rearing many peasants are also engaged in bee keeping. They use traditional beehives and management practices and thus, produce less. The modern beehives, which were introduced during the Dergue regime, disappeared along with the farmers’ producer cooperatives.

### 4.4.2 Feed resources and their management

Natural pasture is the major source of livestock feed. Animals are mostly let to graze on communal pastures. Crop residues constitute the second largest feed source. These are either grazed directly in the form of aftermath, fed at threshing sites, or stored for the dry season. Shortage of feed was mentioned by a number of farmers as a serious problem in the area. It was reported that especially during the dry season, insufficient crop residue and enset are available. Many farmers are not sufficiently aware of crop residue conservation and alternative feed sources such as improved legume forage trees and grass species. In most cases, farmers use crop residues for construction purposes (roofing, walling). This might be one of the causes for the feed shortage.
Residues make important source of feed during the dry season. However, crop residues are not enough to feed the existing livestock population over the extended dry season. Enset leaf, sheath and corm are also important source of roughage. In the study area, 16,400 ha have been allocated for pastureland. This accounts for 3.6% of the total grazing area (457,479.22 ha) of the West Showa Zone. The grasses are dominated by *Perissium shemperi* locally known as *migiraa*, which has less palatability, but has a good ecological value of supporting heavy livestock population and protecting soil from erosion. According to farmers' reports, oxen are used less than ten years on production, and cows give a maximum of five births due to premature loss of teeth when made to graze on *migiraa*-dominated pasture. This makes the livestock feed utilization difficult.

Farmers reported that conservation of crop residue is often a difficult task for them due to the distant location of crop fields from the threshing area or home, besides lack of transportation. This forces the farmers to let the livestock feed on the crop residues on the field. Free access of the animals to crop residues on the field exposes the feed to losses due to trampling by the animals and scattering by wind. Currently, however, with rapid increase of human population and expansion of arable land and with the steadily decreasing size of grazing land, the use of crop residues is increasing. On the other hand, hay preparation is not widely practiced in the study area due to shortage of land, low productivity of palatable grass species, locally called *baallammii*, few fallow land and unpalatable nature of *migiraa*.

### 4.4.3 Livestock management

Farmers in the district manage their livestock in a traditional pastoral fashion. Most of the adult livestock species are herded together. In most cases, the small ruminants and equines follow, cattle being the dominant herd. Small ruminants, however, sometimes are herded with calves around the homesteads. Herding of livestock within a village is made turn by turn, i.e., members of each household keep cattle on tandem bases. This has a contribution for children to attend schools.

Calves in cattle production are kept separate from their dams except when they are used to stimulate letdown of milk twice a day, sharing the production of milk. Newborn calves are given free access to milk of the dam for one to two weeks. Milking starts from 7th to 15th day after parturition, depending on the need of the family for milk. Once milking has been started, the calf's access to the dam will be restricted to few minutes before and after milking in the morning and evening. However, when the dry season prolongs and gets very serious, calves are allowed to suckle their dams freely. Cows give milk for six to ten months, depending on the management and availability of pasture. Farmers reported that they start to train calves to feed on green grass, if available, at the age of two months. However, calves cannot feed on roughage before three months of age for physiological reasons. Calves are tethered in the house or kept around the homestead up to the age of weaning, after which they are let-out with the herd to the grazing area. Mostly, they are weaned at the age of six to ten months.

Bulls are commonly run with cows all year round and breeding is thus uncontrolled. Periodicity of breeding, however, is strongly influenced by seasonal fluctuations with availability of pasture. Farmers told the team that seasonal breeding results in seasonal patterns of calving, availability of milk and butter. The average age of local breed heifers at first mating is four years. First calving is usually at the age of five. The calving intervals are as long as two years. Thus, the reproductive life of a cow is very short, and the number of births is few. This limits the availability of replacement stock, especially for oxen.

Milk yield depends on the availability, quality and palatability of forages. When there is forage and thus good milk production, some of the whole milk is used for babies and, occasionally, for disabled people. The rest is processed into butter, which is usually used as a source of cash income for women, and
cheese, for consumption by the household. The household also consumes some milk during the holidays. Women and children use butter to keep their hair and skin soft. Women use the cash earned by selling butter for purchase of coffee, sugar, salt, soap, onion, spices, house utensils and cover charges for grain milling.

In Tikur Inchini, different types of barns are constructed to secure animals from night predators (hyena) and/or producing manure for the farmland. This is practiced in most peasant associations of the district. Most livestock are housed and/or kraaled separately around the homestead. However, in most areas, the adult cattle and equines are kraaled together while calves and small ruminants are housed separately. Kraals are usually shifted or rotated to fertilize the cropland from the manure, and also keep the animals cleaner, especially during wet periods. This is locally known as chihsaa. During the night, calves and sheep are kept in the house while the rest of the livestock are kept in the kraal, locally called mooraa. It has no roof and well-structured wall that can protect the animals from harsh weather. This reduces the productivity of the animals and makes them susceptible to disease due to stress. Both kraal and housing of equines is common in the area of study.

Mostly the critical feed shortage period starts at the end of December and continues up to mid-March (Table 4.16). During prolonged drought years, the absence of rain at the end of March causes a great loss in livestock. According to an unpublished report of Tikur Inchini district Agricultural Office, about 4% of the livestock died due to prolonged drought during March to April 1999. This report also shows that the maximum number of dead livestock for some households reached about 20 heads.

<table>
<thead>
<tr>
<th>Activity/condition</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>April</th>
<th>May</th>
<th>Jun</th>
<th>July</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tbody>
<tr>
<td>Grazing on Pennistium shemperi (migiru)</td>
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<td>Feeding on crop residues</td>
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<td>Feed adequacy</td>
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<td>Poor body condition</td>
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<td>Better milk production</td>
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<td>High draught power output</td>
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<tr>
<td>Low draught power output</td>
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</tbody>
</table>

The team has also observed a serious feed shortage in the area due to drought locally called hongee. Usually they expect the rain to start in January and the pasture to recover from over-grazing as an elder

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farmer in Nano-Jidu PA stated in the local language, after Oromoo: “Mudde nu mudde Furma nu fure jette dulloomi,” meaning, cows said, January stressed us while February relaxed us.

4.4.4 Animal Health

Animal diseases reduce seriously animal productivity, causing major economic losses. The major livestock diseases in the farming system of the study area are black leg (*abbagorbaa*), pasteurelosis (*gororisa*), African horse sickness (*darbatu*), foot and mouth disease (*qabana'a*), fascioliosis (*bocibocaa*), ectoparasites and poultry diseases.

The first three diseases occur at the beginning and end of the rainy seasons in the form of outbreak. These diseases are of great importance in Tikur Inchiini where high concentrations of livestock population normally graze on communal pasture. The severity of these diseases is aggravated by feed shortage. A loss due to these diseases is about 29% per year according to Tikur Inchiini’s Agricultural Development Office.

Table 4.17 Major livestock diseases as ranked by farmers in Bilo-Abayi and Nano-Jidu PAs.

<table>
<thead>
<tr>
<th>Peasant association</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilo-Abayi</td>
<td>BL</td>
<td>AHS</td>
<td>---</td>
<td>PA</td>
<td>FMD</td>
<td>PD</td>
<td>IP</td>
</tr>
<tr>
<td>Nano-Jidu</td>
<td>BL</td>
<td>AHS</td>
<td>---</td>
<td>PA</td>
<td>FMD</td>
<td>EP</td>
<td>PD</td>
</tr>
</tbody>
</table>

Key: AHS = African Horse Sickness, BL = Black leg, EP = External parasite, IP = Internal parasite, PA = Pasteurelosis, PD = Poultry disease, FMD = Foot and Mouth Disease

Farmers who participated in ranking of livestock diseases at both peasant association and village levels did not mention about anthrax at all as important disease.

Farmers said that vaccination against some diseases and castration services are provided free of charge, but are not available as required, and drugs and treatments are charged. Among the internal parasitic diseases, fascioliosis is the most common one resulting in the decrease of productivity and weight losses. Pasteurelosis is also reported in both PAs. It commonly occurs from the end of dry season up to the beginning of the rainy season. Black leg also occurs seasonally, mostly during the rainy season. Veterinary services in most PAs do not adequately meet the needs of the community due to several factors including:

- inadequate supply of essential drugs;
- lack of transportation facilities;
- shortage of materials and veterinary equipment;
- insufficient and poor veterinary infrastructural facilities (clinic and laboratory); and
- shortage of trained manpower (only two vet technicians in present).

Farmers have their own coping mechanisms against black leg and some external parasites of horses. For black leg they usually mix coffee, garlic and *Cyperus alternifolium*, locally called *bosoqee*, to drench the animal with at an early stage of disease occurrence. They also bleed cattle under tongue, edge of the tail and ear by cutting with needle or blade. For the external parasites, farmers boil fresh cow dung in water and dress the affected part of the animal. They also use a plant locally known as *qarabicho* for the same purpose.

Besides diseases, there are also toxic plants and harmful snails in the pasture of the study area. Three of the toxic plants are locally known as *annannoo*, *korribodka* (corn) and *qeechaa*. Animals are forced to graze on these plants during drought periods and become prone to these poisonous plants. *Annannoo*
irritates the mouth of the animal and also causes diarrhea. *Qoricha* creates bloating and kills within two hours. The minimum amount of *qoricha*, which results in the death of cattle could be one area of research in the future. *Kaarroo* causes loss of balance, bloody urine and kills gradually compared to *qoricha*. Farmers also reported that there is a pasture spider, which causes bloating and immediate death of animals when taken along with grasses at the onset of rain.

### 4.4.5 Historical trend in livestock population

Tikur Inchini is believed to be one of the potential areas for livestock production. Perceptions of farmers on trends of livestock populations, and productivity were assessed through focussed group discussions. All groups of farmers in *Nanno, Gabate, Ganu and Kotie-Gadi* villages reported that there has been an increase in livestock population during the last 20 years.

On the other hand, the number of livestock per household has been decreasing from year to year due to increasing farmer population and diseases. In addition to this, the body weights of the animals and their productivity have been decreasing due to the decline of feed availability.

<table>
<thead>
<tr>
<th>Livestock population</th>
<th>Trend</th>
<th>Factors affecting the trend.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>Increasing</td>
<td>Increase in human population, need for draft power, demand for cattle as security banks, and other necessities.</td>
</tr>
<tr>
<td>Sheep</td>
<td>Increasing</td>
<td>Increase in the need for mutton and income sources.</td>
</tr>
<tr>
<td>Goats</td>
<td>Increasing</td>
<td>Increase in the need for meat and income sources.</td>
</tr>
<tr>
<td>Horses</td>
<td>Increasing</td>
<td>High demand for transportation, as security banks, for manure production and threshing crops.</td>
</tr>
<tr>
<td>Donkeys</td>
<td>Increasing</td>
<td>High demand for transportation of agricultural products and water from distant sources.</td>
</tr>
<tr>
<td>Poultry</td>
<td>Increasing</td>
<td>High demand for poultry products as sources of cash, eggs and meat.</td>
</tr>
<tr>
<td>Grazing land</td>
<td>Decreasing</td>
<td>Increasing demand for cropland.</td>
</tr>
<tr>
<td>Bee colony</td>
<td>Decreasing</td>
<td>Deforestation and use of herbicides.</td>
</tr>
</tbody>
</table>

### 4.5 Livestock-crop interactions

During analysis of the farming system of Tikur Inchini, several complex relationships were determined as shown in Fig 4.5. The farming system is a crop-livestock related in which both are highly interdependent. Livestock provide draft power, transport services, and manure to crop component of the farming system. In addition, livestock generate consumables and marketed items such as butter, egg, live animal, hides and skins for the farmers (whole milk and cheese are not saleable in the community). Draft power provided by oxen is the only source of power for ploughing in this mixed farming system. The availability of feeds, number of livestock and the amount of dung required for fuel affect the amount of manure produced. This limited supply of manure is allocated for crops according to their importance and proximity to the homestead. Manure is applied mostly for enset, maize and other backyard crops. Some amount is also applied on barley, wheat and tef fields.

Different types of livestock are used for threshing different types of crops depending on the nature of hooves of the animals and size of the grains. Oxen are frequently used for tef threshing while horses and oxen are used for barley and wheat. There are fewer donkeys than horses in the area due to their lower economic importance. Mostly they are used for carrying water from rivers, or springs for home consumption. They are also used to transport goods to and from markets and grains to milling services.
As shown in Table 4.19, oxen ownership varies from nil to more than five among the farmers. Some rich farmers possess up to eight heads. The oxen-less farmers constitute about 20% of the farm household in the district. Shortage of oxen has been noted as a serious constraint in the farming system during participatory ranking of the constraints in both PAs and the respective villages.

Different strategies are used to overcome the problem of oxen shortage. In the first place, oxen-less farmers exchange their labor for draft power. A pair of oxen is exchanged for two man-days. Secondly, farmers owning single ox, pair together to use in turns. This coping mechanism is locally called hidhata. Thirdly, farmers with an ox and/or without hire an ox for 200 to 300 killos of grain depending on the type of crops grown in that specific season. This is locally called cimaadaa. Last but not least, some oxen-less farmers may borrow oxen from relatives, after the owners have finished their land preparation and planting. Such farmers may get low crop yield due to late planting which may expose the crop to frost and other stresses. Cattle and horses are used to compact the soil on tef fields before sowing in order to minimize early growth of weeds and their competition. Sheep and goats are considered as security animals because they can be sold to meet immediate financial needs such as payment of credit of fertilizer in bad crop years.
Fig 4.5. Main components of Tikur Inchini's farming system

- Off-farm Handcraft
  - Crop (Barley, Wheat, Tef, Enset, Pulse, Potato, Linseed)
  - Draft tools, wood work
- Labor Traders
  - Cash
  - Information Credit
- External actors
  - Extension
  - Credit
  - NGOs
  - School
  - Clinic
- Livestock
  - Cattle
  - Small ruminants
  - Equines
  - Draft Power
  - Manure
  - Crop residue
  - Construction
- Apiculture
- Poultry
- Grazing and forest area
- Fire wood
- Feed
- Cash Goods Implements
- News
- Market

- Hide
- Manure
- Crop residue
- Construction
Sustainable Agriculture Technology Development and Communication System

5.1 Stakeholders

Agricultural Knowledge and Information System (AKIS) is a system of learning, a set of agricultural organizations and/or persons, and the links and interactions between them, engaged in generation, transformation, transmission, retrieval, integration, diffusion and utilization of knowledge and information, with the purpose of working synergistically to support decision making, problem solving and innovation in a given country's agriculture or a domain thereof (Mettrick, 1993). The major purpose of analyzing the AKIS is to describe the main stakeholders involved in the agricultural R & D systems. It is meant to raise awareness on the process of agricultural innovation, roles and tasks of stakeholders to render more effective and efficient services in the R & D process. Studying the interrelationships among the stakeholders, help to identify the major constraints and opportunities for future improvements. The major stakeholders of Tikur Inchini are presented in Table 5.2.

Linkages among researchers, extension workers, and farmers are useful for successful technology development and adoption. Strong and direct links ensure relevance, rapid feedback and positive impacts through a wider dissemination of agricultural technologies. Experiences have shown that weak links impair research systems by reducing efficiency, impairing performance and diminishing the impact of agricultural research. The key factors influencing links are development policies, capacity and organizational set-up of the involved institutions, resource situations, available technologies and knowledge base, and diversity of agro-ecologies and production systems (Roling and Engel, 1991). Policy contents and pressures from donors, private sectors and farmers' organizations can stimulate institutions to improve performance and build stronger links to address the needs of resource-poor farmers. Strong and committed leadership that can facilitate joint planning and review process, collaborative activities, resource allocation and better communication are necessary to strengthen these links. To create such a favorable environment, the analysis of stakeholders' situations is vital.

5.2 Task analysis and linkage mechanisms

In this context, a task analysis of the major stakeholders and their relationships (Table 5.2) in the process of technology generation, dissemination and utilization in the farming systems of West Shewa Zone in general and Tikur Inchini in particular were studied. An account of this is given below in Table 5.2.
### Table 5.2: Task analysis of different stakeholders in Tikur Inchini, 1999

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Responsibilities</th>
<th>Achievements on the focal areas of the study</th>
<th>Degree of involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPRC</td>
<td>Conduct basic research activities on crop protection</td>
<td>Pathogenic fungi were isolated from chaffer grub, barley leaf rust diseases' yield losses were assessed</td>
<td>Medium</td>
</tr>
<tr>
<td>Holetta Agricultural Research Center</td>
<td>Conduct research on variety development and adoption</td>
<td>Different crop varieties were developed for barley, potato, and oil crops</td>
<td>Medium</td>
</tr>
<tr>
<td>DoA</td>
<td>Extension of package technologies</td>
<td>Different package technologies were disseminated (Fertilizer, chemicals on chaffer grub, afforestation)</td>
<td>High</td>
</tr>
<tr>
<td>Agricultural Cooperation Promotion Department</td>
<td>Promotion of service cooperatives</td>
<td>One farmer cooperative association formed</td>
<td>At infant stage</td>
</tr>
<tr>
<td>Planning and Economic Development</td>
<td>Monitoring and evaluation of development activities</td>
<td>Different development activities were monitored and evaluated for their feasibility (vet clinic, school, ground water, etc).</td>
<td>Low</td>
</tr>
<tr>
<td>ERSHA</td>
<td>Alleviating rural poverty through the empowerment of the less privileged, with special attention to women</td>
<td>Milling service, farmers' saving and credit associations formed, women participation promoted and awareness created.</td>
<td>Low</td>
</tr>
<tr>
<td>Administrations</td>
<td>Policy implementation</td>
<td>Extension activities facilitated, security attained</td>
<td>Medium</td>
</tr>
</tbody>
</table>

**PPRC** was established in 1977. Its major objective is to carry out basic research in crop protection with the aim of finding effective control measures for important pests. The center has been contributing to the productivity of the agricultural sector by generating technologies that alleviate the most important production constraints, namely, pests. Since crop protection research is an integral part of the crop improvement effort, outputs of the center have been incorporated in the breeding programs of other research centers like Holetta, Debre Zeit, Nazareth, Bako and Kulumsa.

Some of the major pests on which the Center conducts scientific investigations include plant diseases (fungal, viral, bacterial and nematode), insect pests and weeds. The major research areas of the center are:

- survey and identification of pests of major crops;
- assessment of loss due to major pests;
- study of control measures including cultural, chemical, biological, host plant resistance and Integrated Pest Management; and
- study of the host range, epidemiology and race analyses of important pathogens, biology of major insect pests, and the like.

During the past two decades several achievements have been made in various disciplines. Accordingly, a large number of pests (insects, pathogens and weeds) of major crops (wheat, tef, barley, maize, sorghum, highland and lowland pulses, oil crops, etc.) were identified and recorded. The losses incurred due to some important pests have been determined. Promising control measures have been devised for some pests.

**HARC** is one of the main stakeholders in Tikur Inchini district. It closely works with farmers on variety screening, adaptation, verification trials and populations study and chemical screening to control chaffer grub. **Holetta Bee Research Center** is engaged in the area by giving advice to the farmers on how to improve traditional ways of bee keeping with better apiary management and handling of hive products. The center is also engaged in identifying, characterizing and selecting geographical races of honeybees in the area.

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Fig. 5.2. Inter-relationship among major stakeholders in Tikur Inchire.
DoA: The objective of DoA is to introduce and extend modern farming technology, environmental protection, to improve farmers' living standards and in general meet the national development objectives. With those objectives, the extension activity in West Shewa Zone is exercised in all the 23 districts. The extension package consists of crops and livestock production, soil and water conservation, agroforestry and post-harvest technology. The package is supported by trained DAs, who live in the farming community. These DAs introduce to the local peasants ways of improving agricultural production and productivity and give them technical assistance. They acquaint the peasant agricultural inputs such as fertilizers, pesticides and herbicides. They also record and report the successes or failures of agricultural production and productivity. However, there is a shortage of DAs; one DA often has to cover more than 1000 households. DAs are also made to spend most of their time in other administrative activities. The above-mentioned and other reasons contribute to the inefficient service provided to farmers in Tikur Inchini district by the few DAs.

ADB: Before the establishment of regional organizations like Dinsho of Oromia, ADB used to facilitate development by extending short-term loans to farmers through the DoA and Agricultural Cooperation Promotion Department, Ambo branch. The loan provided was in terms of cash and/or kind such as seeds, fertilizers, farm implements, threshers, water pumps, etc. A new policy issued for the future activities of ADB focus on encouraging private investors. At present, farmers' services depend on Dinsho for the supply of agricultural inputs and credits.

ACPD: ACPD has three sub-divisions, which enable the department to accomplish its tasks. There are teams of marketing and credit, and audit and inspection. The Cooperation Team has sub-branches at district level. The team teaches farmers about the importance of cooperation and it also provides legal services.

The Marketing and Credit Team helps the cooperatives in solving the problems of market and budget by:
- arranging and facilitating the market and marketing condition for the members of the cooperative in particular and for the society in general. This is to avoid market price fluctuation (stabilizing the market) thereby creating better market condition and facilities;
- facilitating credit for the members of the cooperatives and extending proper follow up for the proper use of credit;
- facilitating access of members of the cooperative to services like flour mills, edible oil mills, shellers, shops, tractors, etc;
- giving technical aids to the cooperatives through formal and on the job training; and
- improving the economic standards of its members.

The teams are closely linked with farmers through their delegates at district and PA levels. The key issue after linkage is teaching about the importance of service cooperatives, registration and legalization. As perceived by the team, their linkage is strong except for the bad experience from the then Dergue's producers' cooperatives, which were established on top-down approach and made the farmers suspicious.

PED: This department, aims at monitoring and evaluation of different activities performed in West Shewa Zone. It evaluates the importance of a project and controls budget utilization. The team cooperates with DoA; Water, Energy and Mineral Department; Disaster, Rehabilitation and Environment Protection Committee; Health Center; Ministry of Education; and WIBS. Monitoring and evaluation of all activities carried out by governmental and private organizations in the zone are the objective of PED.

PED is closely linked with DoA, ACPD and NGOs at zonal level. Also, in rare cases, with farmers when the need arises for evaluation. As perceived by the department, there is/was strong linkage with related stakeholders involved in development.
ERSHA is an integrated rural development program in the Oromia Region, West Shewa Zone, Ambo District, and Guder/Mutulu. It started research in 1992/93, while implementation of activities started in 1994. ERSHA aims to alleviate rural poverty through the empowerment of the less-privileged categories of the society, with special attention to women. It follows a participatory approach in which gender issues and the environment are specifically addressed. The program covers seven PAs; six from Ambo district, and one from Tikur Inchini. Apart from activities in the seven PAs, some activities cover a wider area through cooperation with zonal district line departments. It has three main themes: community participation, gender appraisal and environmental sustainability.

ERSHA has conducted most of the activities on the above mentioned districts efficiently. It also has plans to include other PAs or villages in the study area depending on the needs of individual farmers or PAs. At district level, the department is closely linked with the district council and farmers. At zonal level, however, it works with DoA, DoE and DoH. In addition, it has a strong relationship with DPPD, PED and Zonal Council. PPRC and HARC are also linked with ERSHA at the zonal level.
Chapter 6

CONSTRAINT ANALYSIS AND COPING STRATEGIES

6.1 Socio-economics

Socio-economic constraints are among the factors limiting production, productivity and well being of the farm community. Socioeconomic factors play an indirect role in lowering the productivity of farming systems. Different PRA tools such as matrix ranking, wealth ranking, timelines, labor calendar and village mapping were employed to collect the data on the role of these factors. The reason was to increase precision. Interview with key informants and groups of farmers were also made to collect the data. Some of the problems identified include: (1) Policy problems (land insecurity, credit and input supply policy), (2) Oxen shortage, (3) Unstable market price for grains (4) Seasonal labor shortage.

1. Policy problems

Land tenure policy and its problems

Land is officially the property of government since Dergue regime. Farmers have the right to use but not to sell or exchange. Farmers claimed that land is not used as collateral to get credit. Furthermore, government taxes on land use and agricultural income is among the factors considered in taxation and thus worrying the farmers of Tikur Inchini. This resulted in mismanagement of land, little investment in soil fertility maintenance, and low production. Fear of taxation prevents farmers from giving reliable information on agricultural produce (yield and income).

Input and credit supply policy and its problems

Farmers’ cash sources are very much influenced by uncontrollable factors. As farmers reported, the price of fertilizer increases from year to year. Crop failures due to uncontrollable production problems (frost, hail, erratic rain, etc), low grain price right after harvest, and increased living expenses, have prevented farmers from keeping up with increasing fertilizer price. On the other hand, the input supply policy, which has withdrawn the subsidy on fertilizer, exposed the farmers to inflated price of fertilizer.

Government policy of credit supply is tied with fertilizer and package, which does not give options to farmers for the use of credit. The new policy of the ADB also diverted the extension of credit from farmers to private investors. This adds to the problems of farmers regarding credit utilization. There is no accessible informal and/or formal credit institution well implanted within the farming community. A case study was conducted with a farmer of age 50, in Nanno-Jiddu peasant association.
Introduction
Mr. Kenaha was born in 1949, in Jabduu, Wanno-Jidu PA in Tikur Inchini district. He started farming in 1969, after he got married with his wife, in the same year. The then family establishment-base for youth (the boy’s and the girl’s) was parents’ gift. He and his wife received a pair of oxen and a cow along with her calf; 0.75 ha cropland, farm implements, seed, food items, house utensils etc from their parents. He also mentioned that during the first year of marriage he, in addition to depending on his parents, took 3 timad (3/4th of a ha) cropland to cultivate for his new family. The type of crop he started with was tef. This was because tef was the most precious food and cash crop. On the second year, they were given croplands for barley, tef, wheat, and faba bean in smaller plots.

Trends of his farm
As to his farm growth, he mentioned that dramatic changes occurred, specially on the fertility of the soil, crop productivity, crop type, and family size. His family increased in size from year to year. But the productivity of his land decreased due to decreasing fertility of the soil. Different constraints emerged, risks to cultivate those original crops increased, and shifting to relatively resistant and frost-escaping crops (maize, potato, tef etc) became necessary so as to overcome those risks and uncertainties.

Two decades ago, he used to get 18 to 20 quintal of barley from four timad (a hectare), compared to 8 to 10 today, using fertilizer. The reason is, fertility of the soil had been very high. Nowadays, the fertility of the soil is getting down from year to year due to continuous cultivation. Population increased bringing about reduced farm size, which in turn resulted in withdrawals of follow. This has also contributed to declining soil fertility. To cope with this problem (low yield), he used to add manure, rotate kraal (Ciibsoc), fallow (gargaalchaa), and apply fertilizer.

Financial profitability of fertilizer use
He started to use fertilizer in the Dergue regime (does not remember the exact year). The time he started buying fertilizer, the price was 70 birr per quintal of DAP whereas the market price was 20 birr for a quintal of barley. The net benefit was 510 birr, where the value-cost ratio for the farmer would be 3.94. This was by far greater than the minimum acceptable rate (2.00). It was financially feasible to adopt fertilizer then. Currently, however, the price of fertilizer has gone above his capacity (227.35 birr/quintal for DAP and 164 birr/quintal for UREA). The market price of barley does not balance with the price of fertilizer (130 birr per quintal). The net benefit is 829.275, the value-cost ratio being 2.43 (slightly more than the minimum acceptable ratio (2.00) and much less than the then 3.94). The VCR is decreasing from time to time due to the continuous increase of fertilizer price.

Others problems with fertilizer use
Although application of fertilizers improves the poor soils, it could not bring the fertility of the land to its past level. Moreover, artificial fertilizers need to be applied every year. Nevertheless, soil applied with manure from the very beginning, could maintain its fertility for some years. This shows that fertilizers have a negative impact on the regeneration of the soil. There are also problems with the timely delivery of fertilizer.

Future view of farmer to fertilizer utilization
Because he has lost his capacity to payback the credits and loans, he suggests that he and his colleagues should apply for the subsidy that has been withdrawn to stabilize the price of fertilizer. If the government refuses to respond, he analyzed the real and associated costs of fertilizer utilization, and said they will shift to crops not seeking fertilizer such as enset, linseed, etc.

Case Study on the Economics of Fertilizer Use

2. Oxen shortage
In Tikur Inchini, about 20% of the farmer population are oxen-less. One of the reasons is the increasing number and size of extended families that depend on parental families. The other reason could be that bulls are highly preferred in local markets. This has contributed to the increasing outflow of oxen, bringing about shortage in the district. Farmers also suggested that, for natural reasons, the numbers of male calves born do not equate with heifers. There is also no policy for credit provisions for medium and long-term inputs such as purchase of oxen.

3. Seasonal labor shortage
Hiring of labor is not common in Tikur Inchini. This is, may be, for cultural and economic reasons. Family labor is the major source of labor. Labor shortages appear, specially, during the peak farming periods. Planting, weeding and harvesting times are found to be the major periods of scarcity of family labor.
6.2 Natural resources

Soil fertility decline

Soil fertility decline is one of the major crop production constraints in the study area. The underlying causes for fertility decline include physical factors like high rainfall, steep topography, and erodibility of the soil. Poor farming or cropping practices, unimproved land use systems, and marginalization of the traditional soil fertility management practices have aggravated the rate of soil fertility decline. It is worth noting that population pressure takes the fundamental cause for fertility decline. As the population increased, farmers were forced to continuously cultivate their lands without giving adequate fallow periods.

Soil erosion is the main form of fertility decline in the steep areas. Farmers cultivate steep lands because they assume that crop yields will be less affected by soil pests and frost than in the low-lying bottomland areas. Conversely, nutrient depletion due to continuous cultivation is the main form of fertility decline in the midland and highland areas.

So far, fertilizers are the only available technology being diffused in the area. However, the promotion of fertilizers still faces various technical and economic constraints, such as lack of site-specific recommendation and high prices. In the district, inadequate attempt has been made to implement soil conservation programs. Hence, the rate of soil fertility decline will worsen unless immediate corrective measures are taken.

Farmer coping strategy to the declining soil fertility

1. Kraal manuring (Chibbsa)

Some farmers in the study area practice kraal manuring, locally known as chibssa, in order to improve the fertility of their soils. Accordingly, small barns (temporary fences) are constructed at different places and times to keep cattle temporarily. Then the urine and dung will be incorporated during ploughing. The number of animals, rainfall intensity, the fertility status of the soil determine the number of days that the livestock will be kept in a particular barn. The higher these factors, the faster will be the rotation of kraals over the fields. This is a very good practice, which could be used as a model in other areas too, thus avoiding the problem of transporting manure to very far farmlands, etc.

2. Application of farmyard manure and house refuse

Farmers also use farmyard manure and other house-refuse and decomposed organic matters as organic fertilizers in their land. They usually apply to their homestead cultivated plots. Those who keep calves and sheep in house mainly perform such practices and those have too few animals to make chibssa. Similarly, some farmers also mix the dung with rainwater and send the slurry to their land located on low-lying terrain during rainy seasons.

3. Fallowing

During the past 7-15 years, farmers used to practice long fallowing periods. However, fallowing has been severely diminished recently; some farmers practice very short (usually 1 year) fallowing of their lands. This practice is performed mainly around homesteads. In the current system, short fallowing is made not only for the purpose of soil fertility maintenance but also to grow grass for animals.

4. Crop rotation

It is a fact that an effective crop rotation with regular integration of leguminous crops in the cropping system helps to improve soil fertility. In the study area, the common cropping system is based on cereal production. Accordingly, the rotation system is cereals after cereals. For instance, in the midland area barley/tef/flax/barley/tef/wheat is a common rotation practice. In the highlands the rotation system is
cereal-based. Since the cereal-dominated rotation system is unlikely to improve soil fertility, the integration of some vegetables, potato, horse bean and oil crops should be included in the rotation system to effectively utilize resources, reduce pest infestation and increase crop yield. However, pulse and oil crops are quite marginalized.

5. Fertilizer application
The use of artificial fertilizers as a means to increase soil fertility and crop yields is well known in the area, especially by those peasant farmers who were members of the previous Producers’ Cooperatives. Some farmers are still using chemical fertilizers for crop production though the current fertilizer adoption rate and intensity of fertilization are far from adequate.

A few years back, the amount of fertilizer use in the area was in the order of 55, 61 and 63 kg/ha of DAP for barley, wheat and tef, respectively. Although, few farmers who are included in the new package program apply the recommended rates, other farmers who buy fertilizers by themselves still use very low amounts, about 50 kg DAP/ha.

Forest
The historical trend analysis indicates that in the long past the forest cover in the study area was much greater than at present. The mountain areas were known to be fully covered by natural forest vegetation. Tree cutting or deforestation is the main cause for the declining of forest cover in the area. Farmers over-utilize forests for the purpose of fuel wood, construction materials, and expansion of arable lands. The fact that forestlands are not privately owned, has greatly contributed to the misuse of natural forests, with inadequate control by both the society and the government. The current attempt to develop private wood lots has also been hampered by lack of planting materials, poor management skills and lack of land and/or tree security.

Water and wildlife
So far the water potential of the district is still under-utilized. The available water is used only for drinking and sanitation. The underground and surface water, could have been put into better uses such as small-scale irrigation, water mill development and expansion of mini-hydropower. While lack of clean water is the prime constraint in the mid and highland areas, shortage of water is reported to affect rural life in the steep and mountain areas.

The wildlife in the study area is increasingly at risk from continuous human interference. Farmers have negative attitude towards wildlife in the area since most of them damage their crops. Hunting of wild animals, interference with the natural habitat, and absence of relevant policies are the main limiting factors for wildlife development.
6.3 Crop production

Attempts have been made to identify the underlying causes of low crop productivity in Tikur Inchini (Fig. 6.3). Crop production is severely affected by frost, low soil fertility status of the soil and pest damages. In addition, oxen and land shortage, on top of high input costs are among the major challenges facing crop productivity as discussed below.

Frost
The principal constraint to crop production in Tikur Inchini district is the problem of frost as it damages all annual and perennial crops. The problem is more severe on low-lying flat lands. According to the farmers, no single crop withstands frost and considerable yield loss occurs annually, sometimes resulting in complete crop failure. Pasture land and young trees such as eucalyptus and bamboo are also susceptible to frost damage. It usually begins in October and extends to January. When frost occurs before crop maturity, it shrivels the seeds affecting the quality of the grains. This in turn reduces the market value and germination capacity of the grains. The frost problem is increasing both in area and severity due to weather changes associated with deforestation. Farmers put it this way:

Frost is like a fire on a wooden house. As the fire destroys everything in the house together with the house itself, frost causes a similar damage on all crops. It burns every plant and all crop species. Eventually we end up with empty hands during frost periods.

Declining soil fertility
Soil fertility decline (see 6.2) is one of the major factors that affect yield. For instance, 20 years ago the yield obtained from a local variety of barley without chemical fertilizer ranged from 5 to 10 q/ha, which is now, reduced to a level of 2 to 3 q/ha in Ganu villages. Another effect of declining soil fertility is increased incidence of chaffer grub and weeds such as dima. In addition, crops grown in poor soil become stunted, mature late and are often exposed to frost damage.

Enset wilt
Bacterial wilt caused by Xanthomonas campestris var. musacearum, is the major disease of enset that can kill at all growth stages, including old plants ready for harvest. Farmers are obliged to eradicate a large number of infected plants to check the spread of the disease. At times, devastated fields are abandoned or replaced by other crops. The bacteria is soil-borne and transmitted mechanically. This, coupled with the method by which enset is propagated and managed, has created difficulty to control the disease. So far there is no chemotheraphy or resistant variety to the disease, although few tolerant varieties are known to exist. The disease is spreading alarmingly, threatening enset cultivation.

Chaffer grub
Chaffer grub, locally known as guguhi, is the most important insect pest attacking barley, wheat and linseed seedlings. In a survey conducted by Chilot and Elias (1998), about 83% of the sample households indicated the importance of this seedling pest on dark brown soils. Chaffer grub damage is severe in particular when barley is planted after barley and in the absence of fallow. Farmers also indicated that the incidence and distribution of the insect is increasing due to the declining soil fertility.

Pest control approaches are weak as farmers hardly use the recommended rates of agro-chemicals besides their inefficient cultural practices. The low usage of pesticides is mainly due to their high cost, which the local farmers cannot afford, and lack of adequate supply.
**Low yield of the local land races**
The majority of farmers in the area grow land races, which are low yielders. As a result of inadequate extension services and seed multiplication and distribution systems, the availability of improved varieties is very limited. This has contributed to the continued use of local varieties.

**Red ant**
Red ants attack a wide range of crops, potato and maize being the major ones. The pest occurs frequently both in the dry and rainy seasons. Because farmers lack adequate control measures, the insect is increasing both in number and territory, causing considerable yield losses.

**Maize stalk borer and cut worm**
Maize cultivation has been expanding in Tikur Inchini since the recent introduction of improved varieties. Maize stalk borer and cutworm are becoming major pests, affecting the yield of maize. Lack of insecticides to control these insects led to pest population buildup. The incidence of cutworm has been indicated to correlate with erratic rainfall.

**Diseases**
The farmers' perception on diseases appears to be low. For instance, they mention a local name “shollo” as a major disease attacking barley, wheat, linseed, maize and tef. From their explanation, however, it seems an early frost problem rather than a disease. Rust, locally known as “wag”, is a major disease affecting the production of barley and wheat.

**Weeds**
Yield loss due to competition of weeds is also a serious problem in the area. *Polygonum* sp. and *Bidens* sp. are the two most common weeds that compete with the growth of barley, wheat and tef. *Snowdenia polystachia* is a common weed found in maize fields. In linseed, dodder poses a major threat to production. Declining soil fertility is assumed to enhance the distribution of *Polygonum* sp. while reducing the incidence of *Snowdenia polystachia*. Inadequate application of herbicides coupled with shortage of labor has resulted in insufficient weeding, which further aggravates the yield loss.

**Wild animals**
In Tikur Inchini, the common wild animals, which cause damage at various stages of the crop, are mole rat, porcupine, black crow, and monkey.

**Oxen shortage**
Oxen are the sole source of traction power in Tikur Inchini. Farmers reported a shortage of oxen, especially during peak periods, resulting in low tillage frequencies and delayed planting. Poor tillage affects crop yield through poor germination of seeds, weak seedling establishment and reduced plant population. Delayed planting, on the other hand, increases the chance of frost exposure. Lack of improved farming tools also poses a difficulty to efficient land preparation. As indicated in chapter four, low purchasing power, feed shortage and diseases are the main factors that limit the availability of oxen.

**Land shortage**
Farmers indicated that land holding per household has gone down considerably over time. This has lead to continuous cultivation of the land with reduced fallowing resulting in impoverishment of the soil. Moreover, the yield obtained from a small farmland is very small, limiting farmers’ capacity to buy inputs.

**High input cost**
The high cost of chemical fertilizers, pesticides and improved seeds is not affordable by poor farmers. This has resulted in reduced technology adoption or utilization. Although credit-giving organizations
facilitate the purchase of inputs, their high cost has strongly limited the farmers’ capacity to repay. Moreover, the low price of grains in the market limits household income, and discourages the use of inputs. Farmers complained that they are forced to sell their cattle to repay the credits for inputs especially when crops fail due to bad weather conditions.

Lack of safe drinking water
Most people in Tikur Inchini get drinking water from streams and rivers, which are not safe for health. Hence, a large number of individuals suffer from water-borne diseases. This reduces the availability of active labor necessary for crop production.

Table 6.1 Major production constraints, their trends and contributing factors.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Trend</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frost</td>
<td>Increasing</td>
<td>Deforestation to meet the increasing demands for cropland. Population increase leading to settlement in frost prone areas.</td>
</tr>
<tr>
<td>Declining soil fertility</td>
<td>Increasing</td>
<td>Land fragmentation due to population pressure leading to continuous cultivation and absence of fallowing.</td>
</tr>
<tr>
<td>Enset wilt</td>
<td>Increasing</td>
<td>Lack of control measures such as chemical treatment.</td>
</tr>
<tr>
<td>Chaffer grub</td>
<td>Increasing</td>
<td>Declining soil fertility leading to population build up of chaffer grub.</td>
</tr>
<tr>
<td>Cutworm</td>
<td>Increasing</td>
<td>Lack of appropriate control measures.</td>
</tr>
<tr>
<td>Maize stalk borer</td>
<td>Increasing</td>
<td>Same as above.</td>
</tr>
<tr>
<td>Weeds such as Snowdania sp., Dima</td>
<td>Increasing</td>
<td>Lack of herbicides and shortage of labor during peak periods.</td>
</tr>
<tr>
<td>Rust</td>
<td>Increasing</td>
<td>Mono-cropping of cereals, declining soil fertility in turn reducing the resistance of the crops.</td>
</tr>
</tbody>
</table>

Case Study of the Farming System

Ato Merga Gemechu, 72, was born and raised in Tikur Inchini. He was the eldest child of his parents. When he was 16 years old, he started farming at his father's farm. By the age of 22 he got married, and started his own farm a year later. His father gave him about 6 hectares of land on which a few enset were planted. He started farming by cultivating barley, teff, wheat (Asnake variety), enset, faba bean and field pea. At that time barley was the most important crop. Yield was by far higher than the present time. He used to obtain 24, 5, 4 and 2.5 quintals of barley, teff, wheat and faba bean, respectively, from his land. He also used to produce some 50 kg of field pea every year. The use of fertilizer was unknown.

Fifty years ago, there was no market in Tikur Inchini and hence people were obliged to go to Guder, 25 km away. Then, Ato Merga used to sell a quintal of teff for 14 birr. Although cheap, barley, wheat and gomenzer were also sold. Additional income was obtained from the sale of sheep and ox at a price of about 4 and 40 birr, respectively. Life was easy and cheap. He used to store grains up to two years, as there was no need to take them to the market. Tax was low and special payments to the government were uncommon.

He used to own about 20 cattle, three horses, one mule and five ewes. There was no food shortage.

During the Dergue regime, 25 years ago, three fourth of his land was taken away and distributed to other peasants. Consequently, the family income dropped significantly. Since then, following has disappeared, as land owned per household became very small.

Ato Merga is married to two wives and has ten children. Most of his children got land when the Dergue distributed land to tillers. Currently, his 13 years old boy is at home assisting him, and when he is ready for marriage, Ato Merga is planning to share his piece of land with him.

He says that there are no significant changes in the farming practices except the introduction of improved varieties and fertilizers. In the past, he said, they used to plough at least four times the fallow lands before planting, whereas, at present two times ploughing of the same land is the norm. He expressed his dissatisfaction at the present situation, where food shortage has become a common phenomenon. Had they not been cultivating enset, food scarcity could have been a threat to their survival.
Coping mechanisms of farmers

Farmers at Tikur Inchini have developed several indigenous coping mechanisms to overcome some of the crop production constraints mentioned above. Some of these coping strategies are discussed below.

**Frost**
Frost usually begins in late September. Farmers usually plant early maturing varieties of crops (e.g. barley) that can be harvested before the beginning of frost. They also plant trees around the crop fields of unbroken sequence in ditches, locally known as *kota*, to protect young plants from frost damage. Fully-grown trees serve as wind-break to maintain a microclimate above the freezing point. Planting diversified crops in the same farmland enables to withstand the damage that can be inflicted by frost. For instance, enset plants can stand frost damage. Potato has a short cycle and can be harvested before the incidence of frost.

**Chaffer grub**
*Kraal manuring:* Most farmers in Tikur Inchini practice kraal manuring on the assumption that it reduces the chaffer grub population in addition to improving fertility of the soil. The rationale is that the urine and the treading of the herd kills the insect by limiting their free movement in the soil.

*Reduced tillage frequency:* Farmers are aware that chaffer grubs move more easily in loose soil. Hence, they reduce the frequency of ploughing and plant on rough seedbeds.

*Delayed planting:* Farmers delay planting of some early maturing barley varieties so that the first heavy rains get time to kill the chaffer grub by suffocation in relatively frost-free areas.

*Physical control:* Farmers dig up the soil in order to expose the chaffer grubs to the sun’s heat and predators. Then, they hand-pick them out of their farm as well.

*Seed dressing chemicals:* Most farmers appreciate the potential of seed dressing chemicals to control chaffer grub. However, only few farmers can afford to buy and treat their seeds. Heptachloride is the seed dressing chemical used by those few who treat their seeds.

**Birds**
Farmers minimize crop loss due to birds by dispersing them using slingshots locally known as *wonchif*. It is used to throw more than two stones at a time to relatively longer distances. Children mostly do this.

**Mole rat**
Some farmers at Tikur Inchini flood ground holes with water in order to control rats. Few also use traps to catch moles and porcupines. Fences of *kota* provide an easy guard against bigger pests like porcupines and other small mammals.

**Enset wilt**
Farmers of Tikur Inchni rouge and burn affected plants to minimize spread of the disease.
6.6.3. Problem causal tree for the analysis of crop productivity constraints, labour shortage, demand for fuel, market place.
6.4 Livestock

The major constraints to livestock development in the study area are:

1. **Inadequate supply and poor quality of feeds.**

   Natural pastures, which are the major feed sources in the area, cannot meet the nutritional requirements of the animals, particularly during the dry seasons. This is due to seasonal maturity of *migira*, poor management of the pasturelands, unpalatability of *migira-dominated* grass. The use of crop residues is also constrained by their low quality and poor utilization in most peasant associations.

2. **Prevalence of livestock diseases and inadequate animal health services.**

   Diseases, which have spread in all peasant associations of the district, are the major causes of low productivity of livestock and economic losses. The problems are aggravated by absence of proper disease control, inadequate veterinary services, budget constraints to provide veterinary service, and inadequate skilled manpower to provide the necessary veterinary services.

3. **Poor genetic potential of local breeds and lack of improved breeding program.**

   The indigenous local breeds have naturally low productivity in terms of milk and meat yield and growth rate. There are not enough breeding and development programs to improve the productivity of livestock in the Tikur Inchini farming system. However, genetic improvement goes with improved feeds and management systems.

4. **Lack of adequate infrastructures.**

   Poor accessibility and inadequate facilities of the district have hampered livestock research and extension services in the area.

5. **Land use policy**

   There is a strong relationship between the utilization and conservation of arable, pasture, forest and other land resources. The growth of population and expansion of cultivation has limited the size of the pastureland, thereby imposing high grazing pressures on it. The competition for land among various enterprises can be solved through proper land use policies, which consider the needs and problems of its clients.

**Farmer’s strategies against feed shortage**

During critical feed shortage periods (January - March), farmers supplement animal feeds with crop residues. Special attention is given to oxen because they are used to plough for more than six hours a day. Tef, barley and wheat straws are used as feed supplement in the midlands while only barley and wheat straws are used in the highlands because tef straw is not available. Barley straw is preferred to wheat straw because wheat straw is hard to chew. Tef provides the most preferred straw by livestock.

Indigenous tree species locally known as *anfaar, luggee, shimala, kambolcha*, are used as feed supplement when there is serious shortage of feed. These trees are used from January to March as supplementary feed, but their nutrient values are not studied.

All parts of the enset plant are used as supplementary feed when there is feed shortage. The leaves and sheath of the plant are also used as cattle feed when enset is harvested. Farmers claim that leaves and corm from a variety called *badadeti* provide more energy for animals.
To increase the palatability and regeneration of *migiraa*, farmers burn the pastureland when they expect rain in March and April. This also serves to eradicate external parasites of livestock residing in pasture. This strategy of burning *migiraa* pasture is an old custom inherited from ancestors.

6.5 Stakeholders and their relationships

*Weak linkage and one-way technology delivery*

Crop pests, soil fertility decline and feed shortage were prioritized as the core problems by the team and different stakeholders. These problems were found to increase with time because there is a weak integration and information coordination between stakeholders. A coordinated and integrated approach is lacking. Since the inception of Sasakawa Global 2000 (SG 2000), the DoA took over the Transfer of Technology (ToT) model with the main objective of dissemination of improved varieties and agro-chemicals as packages to farm community. There was a one-way technology and information flow (top-down approach) with little feedbacks for research and development activities.

*Lack of participatory technology development*

Technology development has been done by research mostly based on their own perceptions without considering that of the major clients particularly farmers. There has not been strong coordinating unit or committee that brings together the extension workers and researchers for participatory technology development. Accountability for the clients or farmers was generally absent recognition for indigenous knowledge and practices were overlooked in the past.

6.6 Prioritization of constraints

After the mid-term workshop (see 2.5.2) the team discussed the results of the ranking made by both groups. As indicated in Table 6.2, the farmers identified high input cost and oxen shortage as most important priority problems of crop productivity in the district. The experts attached less importance to both of these constraints, not because they were not serious problems, but because the cause for high input cost and oxen shortage is lack of cash, which requires more developmental efforts than research. Lack of cash means not only these two problems, but also many others. So, the expert group felt that emphasizing these will not provide any additional information, particularly as the aim of the exercise was to prioritize problems that could be used for the development of research proposals.

A baseline study conducted in this district in 1994 showed that soil fertility degradation was felt to be a more important problem than the cost of inputs (Chilot and Elias, 1998). In this study, shortage of oxen was found to be most felt by farmers, followed by frost and chaffer grub. In the present study, farmers did not give high priority to both problems. In 1994, land shortage was the second top problem, while it was ninth at present. Perhaps farmers have realized that intensification could be a solution to this problem. Intensification could be the use of packages of technologies including soil fertility and crop management practices.

Out of the 17 problems identified and prioritized by farmers and experts, eight were crop protection constraints affecting one or more of the crops grown in the district. Considering the low productivity of crops and the critical situation farmers are in, declining soil fertility and pest problems are considered for further study. The highest emphasis was also given to these problems in the previous studies (Chilot and Elias, 1998; Bayeh *et al.* 1996).

A total of ten livestock production constraints were presented for prioritization by the farmers and experts groups. Of these, one is on the type of breed, another on shortage of feed and the remaining eight were on diseases and parasites (Table 6.3). Only few differences were noted between ranking made by the two
groups. The most appreciated problem by both groups was shortage of feed. Problems related to the type of breed, diseases and parasites should be tackled by extension in collaboration with other stakeholders.

Table 6.2 Matrix ranking of crop productivity constraints by farmers and experts.

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Farmers ranking</th>
<th>Experts ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>High cost of inputs</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Oxen shortage</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Soil fertility decline</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Enset wilt</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Rust</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Deforestation</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Chafer grub</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Frost</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Land shortage</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Red ant</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Low grain price</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Wild animals (rodents, birds and monkeys)</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Cut worm</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Maize stalk borer</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Weeds</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Fuel wood shortage</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Land security</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

* = not included in their list.

Table 6.3 Matrix ranking of livestock production constraints by farmers and experts.

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Farmers’ ranking</th>
<th>Experts’ ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed shortage</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>African horse sickness</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Pasteurelloses</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Parasites</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Low genetic potential</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Black leg</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Foot and mouth disease</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Toxic plants</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Poultry diseases</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Pasteur spider</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

In the final analysis, three top constraints were selected for further investigation in the second phase of the study:

- crop pests (chafer grub, enset wilt and rust);
- declining soil fertility; and
- feed shortage.
The team used the following four major criteria to come up with these focus areas for in-depth study:

- priorities of farmers at village and peasant association levels and that of mid-term workshop participants;
- interest and responsibility of the host research center and the TOR;
- capacity of the research centers (Ambo and Holetta) to deal with these constraints; and
- expected adoption rates and the benefits that might be acquired in response to the needs and problems of the farmers.
Chapter 7

FOCUS AREAS AND OPPORTUNITIES

7.1 Crop pests

Pests are one of the major constraints to crop production in Tikur Inchini district. Insect pests like chaffer grub, red ant, cut-worm and others such as mole and porcupine are crop production problems recognized by farmers. Many farmers reported chaffer grub as the most destructive insect pest in the area. Diseases of annual crops however, are not well differentiated by farmers. For instance, all leaf diseases of cereal crops are referred to by farmers as wag. The most important and widely distributed diseases on small cereals are leaf rust, scald, blotches, root rots, smuts and Septoria (Chilot and Elias, 1998). The only recognized and important disease on enset is bacterial wilt. Weeds are also one of the constraints of crop production. However, since they are controlled by hand-weeding and herbicides, they are not problems as such. Among the weeds, Euphorbia schimperiana locally known as "Anano" was abundantly found in crop fields, fallow lands and range land (PPRC, 1997). The plant is poisonous to humans and livestock. Many of the factors involved in crop pest problems are interconnected. These relations are summarized in Figure 7.1.

Chaffer grub (Melolontha sp.)

The dominant dark brown soil in the farming system of Tikur Inchini has a loose texture which is highly favorable for the soil-inhabiting insect pest, chaffer grub. Infestation by the insect is very high in this type of soil than in the red soil. Chilot and Elias (1998) reported that more than two-third of the sampled households in Tikur Inchini suffered from the damage caused by this insect pest. Farmers reported that the infestation is aggravated during drought period when the soil gets dry, allowing easy movement of the insect. Chaffer grub infestation was found to be higher in poor and eroded soils than fertile soils. However, this couldn't be supported by literature and requires a more detailed study. The insect cannot move easily in a wet soil. As a result, it cannot cause much damage during the wet season, but this requires further study.

This insect pest affects many crops grown in the district. However, the damage caused varies depending on factors like type of crop, crop rotation, frequency of ploughing, time of planting, pesticide use and kraal manuring. The effect of chaffer grub on different crops is illustrated in Table 7.1. The insect damages seedlings of barley and linseed more than any other crop. Chaffer grub infestation is moderate on wheat and maize, and slight on tef and faba bean fields. A study on the population dynamics of chaffer grub on fields planted with barley, tef, linseed, wheat and fallow was carried out by the Entomology sub-program of HARC (Bayeh et al., 1996). The result showed the same pattern as stated by the farmers. The population of chaffer grub was high in fields planted with linseed, barley and fallow, the highest being on fallow land. This indicates that fallowing creates favorable conditions for the development of the insect. However, this result is not conclusive because the experiment was done only for one season. The population of chaffer grub remained low on tef fields. Fine seedbed preparation and compaction of the soil by animals before sowing could be the reason for the low population. So, in order to have a good understanding of the population dynamics of the pest, the research has to be repeated over time and space.

A baseline study conducted in 1994 at Tikur Inchini district showed that 77% of the sampled farmers used barley /tef/linseed/wheat/faba bean rotation to ameliorate soil fertility (Chilot and Elias, 1998). Eventhough it was impossible to quantify the number of farmers using crop rotation during the survey, it can be
concluded from interviews made with farmers that the number is greatly reduced because of high population growth in the district. Tef is commonly cultivated in the mid-altitude areas where red soils is dominant. In these areas the infestation by chaffer grub is low. In the dark brown soil only few farmers use rotation. These farmers could benefit from the inclusion of tef/ fava bean in their rotation system to reduce the infestation by chaffer grub. This type of rotation has also been forwarded by the entomologist of HARC during 1998 crop season (HARC, 1999).

Table 7.1 Response of different crops to chaffer grub infestation in Tikur Inchini district

<table>
<thead>
<tr>
<th>Crops/fallow field</th>
<th>Type of infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Severe</td>
</tr>
<tr>
<td>Fallow</td>
<td>+</td>
</tr>
<tr>
<td>Barley</td>
<td></td>
</tr>
<tr>
<td>Linseed</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td></td>
</tr>
<tr>
<td>Tef</td>
<td></td>
</tr>
<tr>
<td>Faba bean</td>
<td></td>
</tr>
</tbody>
</table>

Farmers usually plough once and sow on the second time on rough soil to limit the movement of the pest. Farmers also practice delayed planting because planting on wet soil hinders the movement of the pest and suffocates it to death. Farmers also rotate kraal to fertilize the soil and reduce infestation by chaffer grub. Compaction of the soil due to treading of the cattle, and their urine kills the insect.

During land preparation, members of the household collect and destroy the larvae of the pest. Crows, chickens, ants and even cats feed on chaffer grub. Although none of the farmers interviewed responded positively to the use of pesticides, secondary data indicate that seed dressing chemicals (Aldrin and Dieldrin) are used by farmers in the district. These chemicals have been banned (Chilot and Elias, 1998).

**Bacterial wilt of enset**

Over 200 clones of *enset* exist in Ethiopia (Quimio and Mesfin, 1996), of which about 10 types are found in Tikur Inchini district. Unreliable/low yield of cereals per unit area has forced Tikur Inchini farmers to depend on *enset*. *Enset* itself is, however, affected by fungal diseases like leaf mold (*Cladosporium musce*), fusarium wilt (*Fusarium oxysporium f. cubense*) and leaf spot, (*Cercospora musce*). Bacterial wilt is the most destructive disease of *enset* in Ethiopia (SPL, 1985/86). It is found in 41 districts of Keffa, Shewa and Sidamo regions. Farmers in Tikur Inchini district strongly complain about the problem of bacterial wilt. Survey works done by PPRC in 1985/86 indicated 30% incidence in Bola Kelecha and Melka Dera area near Tikur Inchini district. A typical symptom is wilting of the central leaf. Farmers in Tikur Inchini do not know any other host plant infected by the disease. However, research carried out in the past indicated that it is pathogenic to banana, hot pepper, tobacco, sesame and *Datura stramonium* (*SPL*, 1985/86). These hosts are natural reservoirs from where the disease is transmitted to *enset*. Furthermore, it can be transmitted by banana aphid, leaf hopper and porcupine; infected young planting materials, cattle browsing and straying on leaves of infected plants and by contaminated farm tools. According to farmers perception, the disease increases during the dry (November-May) period. Even though the reason behind is not known by farmers, research findings indicate that the rise in insect-pest population can increase the incidence at higher altitudes.
Moreover, since hot pepper, tobacco and *Datura stramonium* are found near the *enset* plantation, they could be sources of infection too.

The spread and severity of this wilt disease is related to the type of clone, altitude, cultural practices and vector population density (SPL, 1985/86). The ten *enset* clones cultivated in the district differ in their response to the disease. Pair wise ranking by farmers of the *enset* clones indicated clone Badadeti to be the most tolerant followed by Sebara and Shertiye (Table 4.13). The most susceptible was clone Aba-Jobir. Clone Badadeti has been known to be tolerant for over a decade.

*Rust diseases* (*Puccinia* spp.)

Leaf rust (*Puccinia hordei* Otth) of barley, yellow rust (*P. striiformis*) and leaf rust (*P. recondita*) of wheat occur in the district (Chilot and Elias, 1998). Studies carried out at Plant Protection Research Center showed that leaf rust of barley caused 28.3% yield loss (PPRC, 1998). barley leaf rust is more severe than wheat rusts. The weather condition of this district is usually conducive to the development and spread of barley leaf rust. The disease appears even at stem elongation stage and increases as the crop develops further (PPRC, 1997). All local barley varieties are susceptible to the disease. The only leaf rust resistant improved variety is cultivated in the district are HB-42.

The most-liked improved bread wheat variety, ET-13 A2 is high yielding and resistant to rust and other leaf diseases. On the contrary, variety HAR 1685 is not liked by farmers because it is short strawed, uncomfortable for harvesting and susceptible to yellow rust in the area.

7.1.1 Technologies made available by research

As indicated in the above discussion, research information on tolerant/resistant varieties, chemicals, biological and cultural methods of minimizing or controlling these crop pests are available. Heptachloride was used by some farmers against chaffer grub (Chilot and Elias, 1998) A recent, preliminary chemical screening against chaffer grub showed that Marshal and Gaucho control the insect (HARC, 1997). However, the latter was said to be expensive for use by farmers. The study also indicated that there was no significant difference between the chemically treated and untreated plots. This was probably because the infestation of the grub was not uniform on both plots.

Although not much research has been done on chaffer grub in this country, there are technologies produced elsewhere. This pest was controlled by the use of soil solarization method (downloaded from Internet). It was helpful for small scale farms where crops are usually grown year after year in the same soil. This technique takes several months, but is extremely effective in killing soil-borne insects and their eggs, weeds, weed seeds and most disease organisms and nematodes in the soil.

Covering the soil with clear plastic for 6 -10 weeks can generate a high enough temperature in the top 6-12" of soil to kill all pests and weeds. The beneficial effects can last for several years. Mid summer is the best time to solarize beds. Rake and smooth bed, water if it is dry and secure edges with a mound of soil completely sealing the inside. Crop rotation helps to manage some soil pests and soil-borne diseases in addition to maintaining soil fertility. Planting buckwheat or clover on vegetable gardens discourages chaffer grubs.

Additional control measure recommended against bacterial wilt of *enset* is destruction of *Datura stramonium* from *enset* plantation. Cultural practices that help to reduce the amount of bacterial wilt inocula on the field include, exposing the soil to direct sunlight following deep tillage. This is done normally during the dry season prior to planting. Rotation with non-host plant reduces the establishment of the bacteria in the
soil. Cultivating different clones of *enset* in the same plot also prevents the spread of wilt. Seedlings need to be checked for bacterial wilt before transplanting. Beds need to be cleared of old dead plant material that might harbor disease. These materials should be composted so that it is heated and sanitized.

Yield loss due to barley leaf rust under farmers’ conditions was estimated by imposing the disease on a local barley variety for three consecutive years (PPRC, 1997). Mean variation between fungicide-treated and not-treated plots in grain yield was significant. The mean grain yield loss was 28.3%. This study indicated the importance of the disease in the area. It also suggests the need to look into screening for host resistance, chemical and cultural control measures to minimize the losses.

The major improved food barley varieties currently in production are IAR/H/ 485, Ahor 880/61, HB 42, Ardu 12 60B and Shege (Berhanu et al, 1996). They are resistant to scald, blotches and leaf rust. They could be cultivated above 2000 m. The rainfall requirement of these varieties is in the range of 700-1000 mm for the growing season. Each variety has a minimum yield of 1.8 ton/ha. All were recommended for the highland areas of West Shewa including Tikur Inchini. Fungicides like Bayfidan, Tilt and Sportak have been developed for the control of leaf rust, scald and blotches on barley and wheat (Getaneh et al, 1996). However, farmers are not aware of the importance of these diseases, and hence, the fungicides. Besides, there is also the question of affordability.

### 7.1.2. Adoption of these technologies by farmers

Only HB 42 and Ardu 12 60B were introduced into the farming system recently. The former was introduced as a package and the latter was given to ten farmers as compensation for the use of their farms for on-farm trials. Although the adoption rate was not determined, many farmers are interested and preferred HB 42 variety. Similarly, most of the cultural practices used to reduce the infection of bacterial wilt have been widely adopted by farmers. Wheat variety ET 13 A2 has also been well adopted by farmers, whereas HAR 1685 was not liked due to its short straw and susceptibility to disease. Adoption rate studies are required to quantify them in the future.

### 7.2 Declining soil fertility

#### 7.2.1 An overview of the situation

According to peasants, the problem of decline in soil fertility has been considered as one of the prime crop production constraints since the recent few decades. The feeling of an old farmer on its soil condition at Jidu PA has been quoted in the following box:

> **Our soil is losing its natural fertility status and crop production potentials. This started since the last 20 years. Currently, crop yields are extremely low. In the past we used to fallow our lands, which is currently unthinkable practice for many poor farmers. We cultivate it every year to get our food. Generally, the soil now needs to be bribed every year. Unless we apply manure or fertilizer we do not get good yields. Still many farmers, due to poverty, do not adopt these two methods. Please tell us easy and good ways on how to improve our soils?**

Although much of the soil resources are naturally endowed with good properties and favorable fertility status, poor soil management practices and inefficient farming systems are continuously mining the soil nutrients in the area. Existing soil management practices are disappointing. Unless appropriate soil management and soil conservation measures are immediately launched, the possibility of further land degradation is certain.
Generally, many of the soil related problems are amenable to improvements by good soil management and conservation practices. These techniques could not only contribute to reverse the present alarming trend of soil fertility decline but also contribute to raise farm productivity by improving currently unsuitable or less productive land units and cropping systems.

**7.2.2 Indicators of soil fertility Decline**

During PRA sessions old farmers and key informants were consulted and interviewed. Several farmers' indicators on soil fertility decline have been identified and summarized below.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Poor soil</th>
<th>Good soil</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop stand</td>
<td>Poor</td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Crop yield</td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Straw yield</td>
<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Color of plants</td>
<td>Yellow</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>Pasture production</td>
<td>Low</td>
<td>High</td>
<td>Species composition changes based on fertility status.</td>
</tr>
<tr>
<td>Weed competition</td>
<td>Less</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Physical soil</td>
<td>Poor/water</td>
<td>Good/suitable for</td>
<td></td>
</tr>
<tr>
<td>Characters of soil</td>
<td>Poor seed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kraal rotation need</td>
<td>Every year(now)</td>
<td>Every 4-5 years</td>
<td>In the past times</td>
</tr>
</tbody>
</table>

These farmers' indicators are some how in line with normal soil survey procedures used to understand the trend of soil fertility under field conditions.

**7.2.3 Where is the problem severe and who are most affected?**

Although the problem of soil fertility decline is common in all parts of the district, the severity and specific nature of soil related problems differ across locations and land forms. This variation calls for specific solutions and interventions.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy soil</td>
<td>Low drainage, poor aeration, poor workability</td>
</tr>
<tr>
<td>Light soil</td>
<td>Exposed to wind erosion, prone to moisture stream</td>
</tr>
<tr>
<td>Brown/Red Soil</td>
<td>Low organic matter, (poor nitrogen content)</td>
</tr>
<tr>
<td></td>
<td>Highly deficient in phosphorus contents</td>
</tr>
<tr>
<td>Flat/bottom lands</td>
<td>Exposed to wind erosion</td>
</tr>
<tr>
<td>Black/gray soil</td>
<td>High rate of infiltration of rain water, better on content/less N</td>
</tr>
<tr>
<td>Mountain areas</td>
<td>Exposed to severe water erosion /soil conservation is essential</td>
</tr>
<tr>
<td>Open fields</td>
<td>Low organic matter content</td>
</tr>
<tr>
<td>Homesteads</td>
<td>Needs less nitrogen fertilizes</td>
</tr>
</tbody>
</table>

In line with the variation in the severity and type of problem, different members of the community, have their own practices and the influence of the problem varies accordingly.
Table 7.4 Farm categories as affected by soil problems

<table>
<thead>
<tr>
<th>Category</th>
<th>Level of severity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rich framers</td>
<td>Less</td>
<td>Apply, NP, FYM, kraal rotation, fallow</td>
</tr>
<tr>
<td>Poor farmers</td>
<td>High</td>
<td>No inputs</td>
</tr>
<tr>
<td>Less land-holding</td>
<td>High</td>
<td>No fallowing</td>
</tr>
<tr>
<td>Less livestock-holding</td>
<td>High</td>
<td>No FYM, No kraal rotation</td>
</tr>
<tr>
<td>Women farmers</td>
<td>High</td>
<td>Poor land management, limited resources</td>
</tr>
<tr>
<td>Inaccessible Areas</td>
<td>Medium</td>
<td>No inputs and inadequate extension</td>
</tr>
</tbody>
</table>

As shown above, resource poor farmers are the most affected by soil degradation problem. This situation implies the need to devise appropriate, cost effective, and acceptable soil fertility management system in order to address their basic crop production constraints. To this end, future agricultural development interventions in the area must be implemented in such a way that multiple options of soil management are offered to satisfy different farm types.

7.2.4 Problem Causal Analysis and Missing Solutions

Several complex factors have separately or collectively contributed to the decline in soil fertility in the district as shown in Figs. 7.2 and 7.3.

Environmental factors
Rainfall in the area is high and well distributed. But high rainfall and torrential rains severely aggravate the problem of soil erosion. A wide area of the district has steep and mountainous land forms which increase the rate of soil erosion. Moreover, the soil type in the flat and bottom lands are easily blown up by wind because of its light physical properties. Generally, environmental aspects such as topography, rainfall pattern and soil type contribute to the decline in soil fertility. Farmers are also forced to cultivate steep lands to escape the risk of frost. Hence, the frost problem also contributes indirectly to soil erosion in the highland mountain areas.

Cropping systems
The farming system in the study area is entirely based on cereals. In this respect, the range of cultivated crops is narrow and limited to few cereals (wheat/barley). No other crops are adequately integrated in the system. Pulses, which can increase soil fertility, are marginalized. The cereal after cereal rotation system hardly contributes to improve soil fertility.

Several farmers plough their farms 3-4 times to sow their cereals except in soil pest areas where single tillage is the norm. Repeated tillage certainly favors the rate of soil erosion by making the soil loose and easily detachable by rainwater. Generally, the existing cereal-based mono-cropping system is quite inefficient to improve soil fertility.

The mixed agricultural system which has a large livestock population aggravates the core problem through over-grazing of pasture lands, consumption of more crop residues and stubble which otherwise could have been incorporated into the soil.

Decline of traditional practices
Several farmers are well aware of the importance of traditional soil management practices. However, the system trend indicates that these ITK and practices are being neglected and marginalized because of various socio economic problems. Some of the ITK practices and reasons for their decline are presented below.
High infestation of insects (Chaffer grub), and diseases (Bacterial wilt)

Susceptibility of varieties
- Continuous cultivation

Monocropping
- Change of pathogen races
- Food habit

Loos soil structure
- Relatively high organic matter

Land shortage

Low usage of chemical
- Expensive

Expensive

Fig. 7.1. Problem causal tree for the analysis of crop pests and diseases
<table>
<thead>
<tr>
<th>CAUSE</th>
<th>EFFECT</th>
<th>IMPACT</th>
<th>EFFECT</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High rainfall</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slopy areas</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rugged land forms</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frost</td>
<td>Farming on the hills, erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil types</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socioeconomic factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High rainfall</td>
<td>Land degradation</td>
<td>Population pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous cultivation</td>
<td>Land degradation</td>
<td>Land fragmentation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less input use</td>
<td>Continuous cultivation</td>
<td>Poverty/no cash</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure on land</td>
<td>Continuous cultivation</td>
<td>No off-farm job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less technology use</td>
<td>Continuous cultivation</td>
<td>No adaptive technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weak cultivation practices</td>
<td>Continuous cultivation</td>
<td>Weak support service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misuse of natural resources</td>
<td>Continuous cultivation</td>
<td>Poor management of communal resource property</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low technology use</td>
<td>Continuous cultivation</td>
<td>Poor infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less conservation measures</td>
<td>Continuous cultivation</td>
<td>Poor perception and weak farming skill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farming and Cropping system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cereal-based system</td>
<td>Nutrient loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginalization of indigenous knowledge</td>
<td>Nutrient loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monocropping</td>
<td>Nutrient loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enset expansion</td>
<td>Farm yard manure depletion</td>
<td>Poor investment on land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivate marginal land</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High livestock population</td>
<td>Land degradation</td>
<td>Tenure insecurity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of conservation-based farming</td>
<td>Erosion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No crop diversification</td>
<td>Nutrient depletion</td>
<td>Poor land use system</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7.2. Major factors and their effects on soil fertility decline
Table 7.5. System trends in traditional soil management practices

<table>
<thead>
<tr>
<th>Local practices</th>
<th>Reasons for decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kraal manuring</td>
<td>Less livestock holding per household and lack of animals by poor farmers force them to abandon the use of kraal rotation on the open fields.</td>
</tr>
<tr>
<td>Application of FYM</td>
<td>Cow-dung is continuously used as fuel due to shortage of firewood.</td>
</tr>
<tr>
<td>Crop rotation</td>
<td>Pulses and oil crops are marginalized and have reduced area coverage due to pest and frost damages and farmers priority to other food crops.</td>
</tr>
<tr>
<td>Fallowing</td>
<td>Shortage of farmland (reduced farm size/household) forces farmers to continuously cultivate their limited land year after year or fallow period is shortened or being abandoned.</td>
</tr>
<tr>
<td>Crop residues</td>
<td>Straws, stubble and other crop remains are not used to improve the soil, rather they are either collected for house construction, fuel or are immediately consumed by farm animals.</td>
</tr>
</tbody>
</table>

Poor or low technology adoption aspects

The great majority of peasants in the study area are still not adequately exposed to new technologies, which can increase soil fertility and eventually increase crop yields. Modern and productive agriculture is currently unthinkable without a better use of chemical fertilizers.

Presently, less than 20% of the farmers use chemical fertilizers; 75% of which is accounted by the extension plots. The present level of nutrient use is less than 20 kg/ha which is by far less than the minimum level of adoption. Current fertilizer use is even spatially skewed in favor accessible areas. Although an attempt is being made to use recommended rates on farmers' plots covered in the extension program, the rate used by regular farmers is only 50 kg/ha of DAP.

Issues concerning fertilizer use

- absence of sites and crops-specific fertilizer recommendations;
- forced use of 1 qt urea and 1 qt DAP in black/gray soils which are said to have better organic matter content;
- high input costs;
- low prices for cereal crops except tef;
- difficulty to repay credits for fertilizers when crops fail due to pest, rain and frost;
- the use of high fertilizer rates (200 kg/ha) on sloppy lands (up to 80% slope) just to fulfill the quota given by district office for each DC/PA. Erosion takes not only the soil but also the fertilizer;
- poor skills of farmers to best maximize fertilizer use; and
- lack of improved seeds to raise fertilizer use efficiently through synergetic effects.
Policy
Land tenure is becoming less secure than it was during Imperial times. The land reclamation of 1974, which put all lands under state ownership, has deprived the right of land security to peasant farmers. They simply have use – right. This is still unchanged in the present time. The collectivization and settlement programs together with freight land redistribution have contributed to poor control and misuse of natural resources and adversely hamper farm investments. Generally, this system has severely affected the sense of attachment to the land. Farmers are not motivated to conserve natural resources to make farm investments. The cumulative effects have contributed to deforestation, aggravated erosion and promoted soil fertility decline. Moreover, the absence of an improved land use system has contributed to the misuse of natural resources and promoted soil fertility decline. Farmers simply cultivate sloppy and mountainous areas to meet their immediate needs. Practically no soil conservation practices exist. Lands must be utilized based on their suitability and potential. There is a great and continuing competition between various land use systems. Arable lands are expanded to forest and pasture lands. Lands that must be protected and closed are still misused through cultivation. Nobody has done anything to control and stop such devastating situations. The absence of a controlled grazing system, absence of clear guidelines on how to manage, control and utilize communally-owned resources have greatly contributed to the loss of vegetation cover and aggravated erosion.

Socioeconomic aspect
High population pressure is the major socio-economic factor heavily contributing to soil fertility decline. When population increases, more sloppy and marginal lands are cultivated, which in turn promotes soil erosion. As population increases, land fragmentation continues with eventual reduction in farm size. This certainly forces farmers to utilize their land by cultivating them year after year. Fallow periods are severely shortened or totally abandoned. As population increases deforestation also increases because of the increasing need for wood, for fuel and construction. This high rate of deforestation again promotes soil erosion.

Off farm activities and alternative job opportunities and income sources are minimal in the study area. Several people heavily rely on natural resources like trees to secure their lives. Forest cutting, clearing, burning, timber making are not uncommon in several PAs. This misuse and over exploitation of the natural resources aggravates soil erosion.

Poor standards of living and rural poverty also force peasants to over-utilize their resource base without doing anything to rehabilitate, conserve and develop thorough farm investments. Several farmers face critical shortage of cash for their farm investments including the use of external inputs. Other support services are flawed, and adaptive technologies are not readily available for different classes of the community. The role played by external stakeholders is still unsatisfactory. The only available technology is the use of fertilizer, which faces severe problems. There are several leftover, unsold fertilizers, while on the other hand, the adoption rate is quite negligible. Extension services do not promote soil conservation strategies, which should have been considered as a minimum package before any other input. Area-specific research results are lacking. This weak stakeholders’ role does not contribute effectively to improve farmers’ awareness and skills in soil conservation.

Most parts of the area are devoid of rural infrastructures. The road net work is poor. Inaccessible areas are not exposed to new technologies and other services. They are totally isolated. No adequate effort is made to improve the rural infrastructure. All these have adverse impacts on soil fertility.
### Table 7.6 Soil fertility-related problems and missed solutions

<table>
<thead>
<tr>
<th>Problem</th>
<th>Location and Target groups</th>
<th>Missed solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion (Water)</td>
<td>Sloppy areas</td>
<td>Soil conservation</td>
</tr>
<tr>
<td>Low N-content</td>
<td>Red (brown soils / poor farmers)</td>
<td>Organic matter and urea fertilizers</td>
</tr>
<tr>
<td>Low P-Content</td>
<td>Almost all soil</td>
<td>P-fertilizers</td>
</tr>
<tr>
<td>Crop lodging</td>
<td>Black / gray soils</td>
<td>Reduce N-fertilizer rates</td>
</tr>
<tr>
<td>Water logging</td>
<td>Bottom land areas / heavy soils</td>
<td>Drainage</td>
</tr>
<tr>
<td>Moisture stress</td>
<td>Light soils / sloppy areas</td>
<td>Moisture conservation</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Light soils</td>
<td>Wind breaks</td>
</tr>
<tr>
<td>High fertility cost</td>
<td>All farmers / mostly poor farmers</td>
<td>Subsidy services</td>
</tr>
<tr>
<td>Poor land use</td>
<td>Across the district / all farmers</td>
<td>Improve / land use system</td>
</tr>
<tr>
<td>Poor cropping</td>
<td>Across the district</td>
<td>Improved cropping system</td>
</tr>
<tr>
<td>Poor soil workability</td>
<td>Heavy soils / poor farmers</td>
<td>Oxen supply/repeated tillage</td>
</tr>
<tr>
<td>Cash shortage</td>
<td>Poor farmers / across district</td>
<td>Efficient / viable credit</td>
</tr>
<tr>
<td>Flood hazards</td>
<td>Bottom land area / pasture land</td>
<td>Flood control / water ways</td>
</tr>
<tr>
<td>Low pasture production</td>
<td>Across the district and all farmers</td>
<td>Controlled grazing / pasture management</td>
</tr>
<tr>
<td>Input shortage</td>
<td>Inaccessible areas</td>
<td>Road / input delivery</td>
</tr>
<tr>
<td>Low fertilizer use efficiency</td>
<td>Across the district / all farmers.</td>
<td>Maximization of use efficiency,</td>
</tr>
</tbody>
</table>

### 7.3 Feed shortage

In the mid-term workshop, feed shortage was found to be the main limiting factor to the productivity of livestock in Tikur Inchini. Hence, a detailed field study was made on this problem using a focused checklist.

**Causes of feed shortage**

Immediate causes of feed shortage were assessed based on information gathered from key informant farmers, DAs and BoA at Tikur Inchini. As can be shown in Fig. 7.5, several factors contribute to feed shortage.

Human population growth has resulted in increased demand for cropland and cattle. This in turn has resulted in decreased pastureland sizes with higher stocking rates. The higher the stocking rate, the higher the overgrazing, leading to shortages of feeds. Moreover, communal ownership has resulted in mismanagement of pastureland by the community. Some community members bring cattle of their relatives from the neighboring districts and PAs to graze on the communal pastureland. This inflow of cattle has both positive and negative impacts. The individuals who bring in their relatives’ cattle get some advantages of draft power, milk and similar benefits. On the other hand, it creates conflict among the community members who share the communal pasture, hampering responsibility and leads to mismanagement.

The other cause for seasonal feed shortage is delayed onset of rainfall. According to farmers, the first shower of rain usually comes in January. This enables regeneration of grass species. As a result, February is the period for the revival of livestock. Sometimes, however, the rain delays up to May causing severe feed shortage, which results in critical weight loss and death of many animals.

Until recently, there has not been research done in the area to develop, verify, and demonstrate new technologies on pasture and forage improvement. Neither adaptability nor screening trails of forage crops has been made in Tikur Inchini.

Extension service is the most important tool through which appropriate technologies and research results are demonstrated and transferred to the farmers in order to increase their productive capability. Nevertheless, there was not any forage extension activities performed to curtail the problem of animal feed.
Periods of mating and lactation
Mostly conception occurs during the rainy season when pasture is available (April-May); and births in the dry season (January to February), when forage is extremely scarce. As a result, cows become undernourished and fail to produce sufficient milk either for the calves or the household. This results in a retarded growth and/or death of calves. Normally, the first three months after birth were supposed to be peak lactation period. Unfortunately, however, farm households of Tikur Inchini do not have this opportunity.

Type of livestock affected during feed shortage

Cattle
Not all livestock types are affected equally by the feed shortage. Cattle are affected more than others. Within cattle, lactating cows are more affected by feed shortage followed by calves, oxen, bulls, dry cows and heifers. Oxen and lactating cows get supplementary feed, i.e., crop residues and enset. During the dry season, cows after parturition are also supplemented with enset and roasted and milled barley. Farmers do this to reduce the weight loss due to suckling.

Sheep and equines
Sheep and equines are less affected than cattle, because they can graze on short grasses more efficiently. They are also able to graze selectively on palatable grass species resulting in overgrazing.

7.3.1 Technologies made available by research
So far, there is no research conducted in the study area concerning feed shortage. However, technologies have been generated from Holetta agricultural Research Center for highland agro-ecologies. Therefore, emphasis should be given to introduce the appropriate ones to Tikur Inchini. According to Alemayehu (1997), technologies that can easily be introduced into the Tikur Inchini farming system include:
- Pasture improvement and management (over-sowing with common vetch and burning of “migiraa” grass at early rainy season)
- Under-sowing of cereal crops with forage legumes (common vetch)
- Field forage crop production (clovers, alfalfa)
- Backyard forage development (tree lucerne, elephant grass, enset, fodder beet)
- Establishing forage species on stock exclusion areas to improve soil fertility and provide forage for cut and carry management (tree Lucerne)

7.3.2 Adoption of technologies by farmers
Alemayehu (1997) stated that different forage development strategies have been adopted in agro-ecologies similar to Tikur Inchini. These technologies include under-sowing, backyard forage development, forage production, and establishment of forage species on stock exclusion areas. However, these have not been properly extended in the Tikur Inchini district. This is mainly because of shortage of extension specialist and lack of attention as well.
Fig. 14. Problem-casual tree for feed shortage at Tikur Inchini
7.4 Opportunities

7.4.1 Crop production
The following opportunities are identified in response to crop production problems of Tikur Inchini:

- introduction of new crops or varieties or ensset clones that are resistant to important pests and/or diseases like chaffer grub, bacterial wilt and leaf rust to increase the yield per unit area;
- introduction of crop rotation to manage some soil insect pests and soil-borne diseases in addition to improving soil fertility; and
- the damage caused by chaffer grub on tef is low, because of kraal manuring and soil compaction before sowing. This cultural practice, therefore, may be followed for all the crops grown in the area in order to reduce grub incidence and increase production.

7.4.2 Livestock

- Tikur Inchini has large area of grazing pastureland. To improve the productivity of livestock in the area, strengthening of research and extension activities regarding screening and introduction of improved tree/shrub legumes and forage crops along with improved cattle breeds will be important tasks;
- extension of the existing family planning services to the rural areas is very important to control population growth;
- enhancing intensive crop production may help to reduce competition for pastureland and can produce more crop residues; and
- maintaining the existing trend of tree planting. More emphasis should be given to plant and use of forage legumes, fodder roots, grass strips and multipurpose shrubs around backyard and rely cropping of forages with cereals need to be encouraged on crop fields.

7.4.3 Natural resources

Water resources
- there is rich surface water potential;
- there is vast opportunity to utilize underground water potential;
- there is immense potential to develop small scale irrigation;
- small scale hydropower and water mill potential exists; and
- waterfalls are available for local tourism and other economic uses.

Forest
The study area is well endowed with vast potential of forest. Both the soil and climatic conditions offer suitable for tree plantation. Under this condition it is apparent that not only protective forestry, but also productive commercial forests could be effectively established and utilized in the future. In this connection the opportunity to grow timber, pulp wood plantation, and fuel wood forests is inevitably promising. In the future this unutilized development opportunity and potential has to be put in to best economic use and benefits.

It is well known that there is a growing demand for forest products in the country as well as around the study area. Because the district is close to Ambo and Addis Abeba, the presence of dependable market for any type of forest products is unquestionable. In general, the existing favorable growing conditions, accessibility and dependable markets have to be exploited through developing commercial and industrial forest plantations. To this effect, tree species like eucalyptus, cupressus, bamboo and other industrial tree
species could be established and expanded by farmers, government body or private investors. Moreover, agroforestry could also be introduced and tested at different locations. For such tasks, it is pertinent to study the most suitable agroforestry systems and practices, which could be easily prompted in the prevailing farming system conditions.

7.4.4 Socio-economics

As the core objective of the study is to analyze constraints and opportunities for Tikur Inchini farming system on participatory bases, the possible opportunities through which these problems can be solved are listed below.

- institutionalization of COR at national level, and participatory R & D;
- enhancing intensive rather than extensive crop production;
- establishment of local farmer-based credit and saving associations;
- strengthening networking among stakeholders working in similar areas; and
- passing policies that encourage specialization of production (cash/food crops or livestock)
Chapter 8

RECOMMENDATIONS AND RESEARCH AND DEVELOPMENT PROPOSALS

8.1 *Crop production*

- survey on barley, wheat and *enset* diseases in Tikur Inchini district should be conducted to be able to identify existing diseases and know their incidence, severity and distribution and subsequently appropriate control measures;
- survey on insect pests of barley, wheat and *enset* so as to identify existing insect pests and know their incidence and distribution. The importance of the pests should also be quantified through loss assessment studies on farmers’ fields with the participation of the farmers;
- study on an integrated method of chaffer grub management on farmers’ fields. This is to find out immediate solutions for the chaffer grub problem by using seed-dressing chemicals and compaction of seedbeds by animals before sowing any crop susceptible to this pest;
- study the effect of locally available materials for controlling bacterial wilt of *enset*. It was said that human and sheep urine as well as horse’s feces diluted with water reduce or control this destructive disease;
- the already known information to control bacterial wilt of *enset* should be published in a form of leaflet and distributed to farmers;
- host resistance, seed-dressing and foliar pesticides against insect pests and diseases of cereals and *enset* should be studied; and
- study on the population dynamics of chaffer grub under fertilized and unfertilized barley or other crops be conducted so as to confirm whether the infestation of chaffer grub increases on poor soils or not as commented by the farmers.

8.2 *Livestock*

1. Community-based sustainable pastureland management.
   - a participatory, community-based pastureland management and improvement system need to be developed;
   - increasing feed supply by selecting crops with high nutritional values in their residues; intercropping herbaceous and tree legumes with grain crops for higher biomass production and nutritive quality per unit area;
   - devising appropriate alternative livestock husbandry techniques with emphasis on quality rather than quantity. This will also contribute to the control of stocking rate on the existing pastureland;
   - developing technologies that maintain positive interactions among crop, fallow and pastureland;
   - improving the palatability of *Pennistum shemperi* grass; and
   - proper extension services to establish local demonstration, multiplication and distribution sites in order to introduce appropriate and suitable legumes in the *Pennistum shemperi* grassland

2. Improving or developing alternative feed resources.
   - farmers’ current feed shortage, copping strategies need to be researched. New technologies should also be developed in this line; and
   - devising appropriate residue management techniques.
3. Providing sustainable extension services,
   - qualified extension workers need to be assigned in sufficient numbers; and
   - the extension service should address all aspects of the farming system.
4. Availing credit facilities and agricultural inputs,
   - credit facilities for livestock production should be developed; and
   - inputs for livestock production, such as improved pasture seeds, crossbred heifers, pullets, cock, AI services, modern beehives, and veterinary services should be made available.
5. Identification and characterization of existing bee colonies and honey plant species used for honey production in the area.
7. Alternative sources of draft power.
   - research should find ways of using horses and donkeys as alternative sources of draft power.
8. Animal health care
   - development activities should focus on providing adequate veterinary services.

8.3 Soil management and utilization

Soil conservation
So far no effort has been made to conserve and judiciously utilize the soil resource-base of the district. To this effect, both the farmers and other stakeholders have not made any meaningful efforts in popularizing and implementing soil conservation measures. Virtually, no attempt has been made to control erosion on cultivated lands. In view of the fact that the soils in the area are at constant threat of erosion, it is high time to popularize and adopt effective soil control and conservation measures with immediate focus on the mountain and sloppy lands.

Improved land use practices
As the current land use system in the area is neither productive nor sustainable, there is a crucial need to develop and adopt improved land use practices. Hence, action must be taken towards changing the existing system, which is based on short-term interest of farmers, by launching and implementing viable and sustainable land use.

Better land security
Peasant farmers need to have better guaranty and security for their arable and forestlands. It is quite apparent that better land security could contribute towards motivating farmers to conserve their lands and promote long-term farm investments. Attention must be given to control and legally avoid further land redistribution.

Improved cropping systems
The existing cropping system, which is featured by cultivation of few cereal crops, does not effectively contribute to improve soil fertility. Due attention is required to expand the range of cultivated crops including pulses to maintain soil fertility.

Conservation-based agronomic practices
Crop production in the study area must be linked with conservation-based agronomic practices. Although all cultivated lands need focus, due and immediate attention must be given to sloppy and mountain areas.

Promote fertilizer trials
The existing fertilizer use in the area is not supported by area-specific fertilizer recommendations. A lot of farmers protest that they do not get a good response from the use of urea on the black soil at the
package recommended rate. Hence, future fertilizer use and promotion need to be supported by results of site-specific fertilizer trials.

Initiate integrated plant nutrition system
Agricultural productivity and sustainability in the study area could be promoted through implementing integrated plant nutrient system (IPNS). IPNS can provide multiple advantages through promoting organic farming practices: reduce fertilizer consumption; promotes the use of bio-fertilizers and eventually help to maximize fertilizer use efficiency.

Improve and effectively utilize indigenous skills and practices:
Although there is a declining trend and marginalization of the use of ITK on maintenance of soil fertility, there is still immense opportunity to effectively exploit such local practices in the future. To this end, due emphasis has to be given to overcome factors inhibiting the continuous use of these local soil fertility maintenance practices. Moreover, R & D works need to be initiated to maximize the efficiency and effectiveness of these traditional practices.

Family planning
High population pressure has been known to be one of the major factors for soil fertility decline and land degradation. Since the population size in the area is increasing, future development interventions should give due attention to maintain the population at acceptable level through effective family planning and related social services.

Forest management
Control deforestation
In order to maintain the natural vegetation and forest resources of the study area, effective measures must be taken to control deforestation. Deforestation is known to be the prime cause for the misuse and over-exploitation of the natural forest cover. In line with this, all attempts to burn natural forests, to cut down trees, and to expand arable lands to sloppy and mountain areas, which are originally covered by trees, must be legally avoided.

Encourage private forest development
Due emphasis need to be given to develop private forests in the study area. Private forests could be established either by private investors or individual farmers. By availing planting materials, plastic tubes and providing training on seedling and tree management can be encouraged.

Develop nursery sites
Shortage of seedlings and planting materials for forest development has to be alleviated by establishing adequate nursery sites, at least at PA level. Efforts have to be made to include the tree species chosen and preferred by farmers. However, equal attention should be given to indigenous tree species.

Develop and supply alternative energy saving sources:
There is an acute shortage of fuel wood in the area. Attempts must be made to develop and introduce alternative fuel sources like biogas and kerosene. Energy-saving stoves can also play a big role in reducing the rate of firewood consumption, and hence, deforestation.

Area closure on degraded and fragile lands
Area closure is an easy and feasible practice that helps the degraded lands and vegetation to rejuvenate in a short time. The sloppy, degraded and eroded lands must be put under area closure until the natural
vegetation recovers. In general, area enclosure is perceived as the cheapest, cost effective and technically viable practice.

**Alternative income and job sources**
Most people in the area depend on forest and forest products to lead their life. This people do destroy the forests for charcoal, timber making, etc without any effort in maintaining the resource base. Hence, alternative job opportunities for additional financial requirements should be created.

**Promote protective forestry**
The prime focus for future forestry development in the sloppy and degraded areas is promoting protective forestry development. Species selection, management plan and other related issues have to be oriented towards protecting the degraded land and forest spices prone to denudation.

**Promote productive forestry**
Commercial forestry could be one focus area mainly for individual farmers and private investors. There is immense potential to develop commercial forestry in the study area.

**Redistribute degraded and wastelands to individuals**
Wastelands will be best managed if delivered to individuals. This has been tested in regions 1 and 3 and was found to be promising. Degraded and wastelands have to be redistributed to community members for the development of both protective and productive forestry.

**Water management**

**Spring and ground water development**
Springs and ground water potential of the area mainly in the bottom and gently slopped lands is quite massive. Future hydrological developments need to be linked to effective utilization of this massive resource potential for household consumption and related uses.

**Better water supply networks**
Except in the district town there is no water supply scheme in the area. There is acute shortage of drinking water in mountain area like Tukie/Rogie PAs. Future rural development in the area must solve the shortage of water. The community, donors and the regional government should collaborate to tackle this water shortage problem.

**Water treatment**
Although there is enough water in the district, mostly it is not safe for drinking. This problem is more severe in river and pond waters. Effective water treatment services should be one of areas of focus in the future.

**Small-scale irrigation development**
Although there is a big opportunity in the study area, both traditional and modern irrigation is still undeveloped. Small-scale irrigation schemes for vegetables, cereals, cash crops, horticultural crops and pasture could easily be developed.

**Water mills**
There are currently only two water mills in the area, which render services to peasant farmers. Development of more water mills will save time and labor which the farmers can use for other development activities. It will also contribute to proper and efficient utilization of the resource.
Hydropower

Small-scale hydropower can be established using the waterfalls of big rivers like Tikur/Guder River. In a study made on the Blue Nile River basin, the potential and feasibility of Tikur River (Guder) for hydropower generation has been established.

8.4 Socio-economics

- some of the technologies developed in the past were found to be economically not feasible. A very good example is fertilizer. It was accepted for its ability to maintain soil fertility/increase crop yield. On the other hand, the price is not affordable by farmers. This might have come because the circumstance in which the farm community is found has not been considered. In solving this and similar problems, future R & D activities should involve the clients. Consideration of different clients such as farmers, consumers, traders, etc is of paramount importance;
- in the law of demand and supply, price increase if the demand exceeds the supply, and vice versa. The large supply of grains in the market during harvesting greatly reduces the price farmers get for their grains. On the other hand, farmers are forced to pay their credit during low market demand for their crops. To reduce this problem, the government should encourage private or public grain trading enterprises to purchase the grains when prices fall and sale them back at a fair price when they rise;
- gender roles should be considered in R & D programs. Participation of both women and men is crucial to understand farming system constraints and innovate for the same;
- in the meantime, DAs should focus on extension services. They should not be involved in administrative activities, which roughen the relation between extension and farmers; and
- credit institutions should be established on participatory or cooperation basis.

8.5 Agricultural knowledge and information systems

Strengthening linkage between different stakeholders
Past linkage between stakeholders was weak. As the goal of every organization is to bring sustainable and client-oriented development, strengthening the interrelationship between the stakeholders is of paramount importance. Effective linkage may help generate knowledge and information, which enable to devise client-oriented approach.

Improvement of participatory R & D approach
Farmers should participate in research from problem identification to technology generation and utilization. It is also important to consider farmers’ circumstances and their roles in development activities. This is because the past R & D activities should be compatible with the local conditions. Most of the technologies developed by research were found to be unsuitable by the farmers.

Institutionalization and strengthening of stakeholders coordinating body
Effective information communication could be attained through institutionalizing and strengthening of legal coordinating body with its budget. This may enhance the linkage between stakeholders and facilitate the information dissemination systems. It will be a good forum for presentation of results by different stakeholders so as to exchange and share experiences as well as outputs. The outputs will be published and distributed for the stakeholders for future plan. This can also help break the barriers among them, create openness and awareness of participatory approach.
An integrated and participatory management of chaffer grub for different crops

Background and Justification
Chaffer grub is a soil-dwelling insect pest mainly found in Tikur Inchini district (Bayeh et al, 1996). It is widely distributed in the dark brown soil, which comprises 80% of the soil in the district. Chaffer grub is a polyphagous pest infesting mainly barley, linseed, wheat, maize and tef. The damage caused after fallow is more serious because this cultural practice favors the reproduction of the insect pest during the whole year. Apart from the chemical control of the pest, farmers observed that tef was not highly infested due to kraal manuring and compaction of the soil by animals. This indigenous knowledge was also confirmed by entomologists of Holetta Agricultural Research Center (HARC, 1998). Therefore, since the problem is very serious in the district, it is essential to study the combined effect of the chemical treatment with the cultural methods in order to reduce the infestation and increase yield per unit area.

Objectives
• to determine the combined effects of seed-dressing chemicals and cultural methods; and
• to compare the effect of these control measures on different crops.

Expected outputs
• effective and efficient chemical and cultural control measures of chaffer grub will be known; and
• farmers will be aware of the control measures.

Study on the efficacy of locally available materials against bacterial wilt of *enset*

Background and Justification
Bacterial wilt of *enset* is distributed in 41 districts of Shewa, Sidamo and Kefa regions (SPL, 1985/86). Tikur Inchini is one of the districts where the disease is widely distributed. Earlier research works indicated that about 30% of the plantation was affected by bacterial wilt in the nearby PAs around Tikur Inchini district (SPL, 1985/86). Even though, farmers are applying most of the cultural control measures correctly, the disease is increasing year after year. The incidence increases during the dry period and there is a complete loss of the *enset* plant after infection. So, since this crop is a staple and dependable food for the farming community of the district, it is high time to find out control measures for the disease.

Objectives
• to study effect of human and sheep urine as well as horse feces for the control of bacterial wilt; and
• to establish simple, practical and effective methods of controlling *enset* wilt for future use.

Expected outputs
• efficacy of the materials will be established;
• methods of application will be known; and
• awareness of the traditional controlling methods will be further developed.
Fertilizer trials on major cultivated crops

Background and justification
The use of fertilizer in the district is not supported by area- and crop-specific studies. Farmers use similar fertilizer types and rates on different crops and soil types. In this respect there is great problem in the effectiveness of nitrogenous fertilizers mainly on black soils. On the other hand, there are good crop growing conditions to expand fertilizer use within the economic optimum rates.

Objectives
- assess the impacts of NP fertilizers on different crops and soil types in the area;
- develop economic optimum rates for the various cultivated crops; and
- assess the short and long-term impacts of fertilizer use on the environment.

Expected outputs
- location and crop-specific fertilizer recommendations will be developed within the context of economically optimum rates; and
- efficient use of chemical fertilizers.

Integrated Plant Nutrition System (IPNS) Trials

Objectives
- to assess and describe the local plant nutrient sources available in the area;
- to introduce improved IPNS techniques and verify them in the area; and
- to make use of IPNS and eventually reduce the amount of chemical fertilizers that will be applied to cultivated farms.

Expected outputs
- farmers' perception on IPNS will improve;
- dependency on chemical fertilizers would be reduced;
- soil properties will be improved;
- crop yields will raise; and
- ecological pollution from the use of high fertilizer rates will be minimized.

Soil conservation development program

Background and justification
Quite a large area of the district is exposed to severe soil erosion problem. During this study, it was noted that lands with 60-70% slope are cultivated virtually without any conservation practices (Tokie/Rogie PAs). Under the existing quota-based extension system, farmers in such areas are even forced to apply vast amounts of fertilizer, which is easily exposed to erosion. Throughout the district farmers or agricultural offices currently perform either little or no soil conservation activities. Past studies made by NSCRP in central highlands of Ethiopia indicate a mean soil loss of 70 t/ha/yr, while the maximum reaches up to 300 t/ha/yr. Although the problem is more severe in slope lands, there is no tolerable/permissible level of soil erosion in the country. Hence, it is high time and very crucial to launch and implement strong soil conservation program in this district.
Objectives
- to control soil erosion in both arable and non-arable lands;
- to rehabilitate degraded and waste lands;
- to increase the population carrying capacity of natural resources;
- to develop and raise farmers perception and skills on soil conservation; and
- to contribute to get productive and sustainable agriculture.

Expected outputs
- reduced soil fertility decline;
- best use of degraded and wastelands;
- crop yields and farm incomes improved; and
- vegetation and other resources rehabilitated eventually contributing to sustainable ecosystems.

Participatory research on palatability of migira grass /Pennistum shemperi/ in Tikur Inchini

Background and justification
Livestock feed was found to be one of the major problems limiting production. The feed source of the area includes pasture, crop residues and enset. According to Chilot et al, 1998, migira grass, the dominant pasture spp, has been unpalatable and causes premature teeth loss of the animal when they made to graze it. This also reduces the productive life of the animal. On the other hand farmers used to burn the grass to make regenerative tillers in order to feed their animals. However, no research has been conducted to explicit the problem and forward probable adjustment/recommendation/

Objectives
- to examine the factors contributing to the unpalatability of the grass;
- to examine the reasons why the farmers burn the grass, and thereby identify the palatable stage of the grass; and
- to recommend possible alternatives

Methodology
Capacity building
Farmers will be trained for the purpose of recognizing why and how this research is made, and how much it is important to tackle feed shortage. This is aimed to familiarize and introduce participatory research approach.

Data collection
Data assumed to be very important and will be collected on participatory basis with other stakeholders.

Expected outputs
- familiarity with participatory approach;
- unpalatability factors of migira pasture identified; and
- palatable growth stage of migira known and recommended.
Participatory forage species trials

Background and justification
In Tikur Inchini district, feed shortage has been the limiting factor in livestock production. However, different improved forage species were developed at different conditions. These include common vetch, alfalfa, clover, tree lucerne, fodder beet and enset. These can be used as some of the options, which could be used as a treatment in further adoption trials. Nevertheless, no trial has been conducted to enhance participatory adoption trials on forage species.

Objectives
- to introduce improved forage species on participatory basis;
- to further verify the adaptability of improved forage species at Tikur Inchini; and
- to give participatory recommendation on compatible forage species.

Methodology

Phase 1: Training
Farmers will be trained why the trial is needed, how it could be implemented will also be given for them, in addition to the importance of participatory approach. In general every technical step in adoption like lay out will be given.

- site selection will be made, taking into account representative zones, (zone 1, zone 2 and zone 3) identified and farmer typologies (resource rich, medium resource and resource poor);
- layout after site selection, the plot sizes and their replications will be determined with farmers. The design should also be devised;
- recommended and farmer practices should be considered for agronomic practice so as to make comparisons;
- harvesting will be done on participatory basis; and
- evaluating and managing techniques will be made and devised, respectively.

Phase 2
This phase may be proceeded if satisfactory information for recommendation is not obtained.

Expected outputs
- participatory approach in research awarded;
- farmer-based forage species will be recommended; and
- farmer to farmer seed exchange and production facilitated.
References


FAO. 1991. Land Suitability Classification, Assistance to Land Use Planning, No 3, Rome, Italy.


### Appendix 1. Field study plan

<table>
<thead>
<tr>
<th>Week</th>
<th>Activities</th>
<th>Place</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 1-7</td>
<td>Introduction the host center, Reconnaissance survey, secondary data collection and analysis</td>
<td>Ambo, Tikur Inchini</td>
<td>Field observation, Informal discussion, Literature review</td>
</tr>
<tr>
<td>March 8-15</td>
<td>Planning workshop, refining checklist, team introduction and PRA, data compilation and analysis</td>
<td>Ambo PPRC, Bilo-Abayi, Nanno-Jiddu</td>
<td>Presentation, PRA, Team analysis</td>
</tr>
<tr>
<td>March 16-23</td>
<td>Data compilation and analysis, formulating focused checklist, data collection</td>
<td>Ambo PPRC, Kotiye-Gadi village, Genu village</td>
<td>Conceptual framework analysis, Matrix ranking, resource mapping, individual/group interviews</td>
</tr>
<tr>
<td>March 24-30</td>
<td>Data compiling and analysis, preparation for mid-term workshop</td>
<td>Ambo PPRC</td>
<td>Analysis of constraints and opportunities, conceptual framework, visualizing problem tree</td>
</tr>
<tr>
<td>March 31</td>
<td>Mid-term workshop</td>
<td>Tikur Inchini district, town</td>
<td>Presentations and discussions</td>
</tr>
<tr>
<td>April 2-9</td>
<td>Developing focal areas, formulating focused checklist for each focal area, data collection</td>
<td>Ambo PPRC, Nanno-Jidu, Bilo-Abayi, Roge-Danisa, Bola-Roge</td>
<td>Problem analysis, key informant interview, individual interview, wealth ranking</td>
</tr>
<tr>
<td>April 10-17</td>
<td>Refining checklists, data collection, case studies, team discussion</td>
<td>Ambo PPRC, Wale village, Kotiye-Oli village</td>
<td>Gap-analysis by discussion made on the data collected, wealth ranking, interviewing individual and key informants</td>
</tr>
<tr>
<td>April 18-25</td>
<td>Data analysis and compilation, team discussion, screening different problems</td>
<td>Ambo PPRC</td>
<td>Team work</td>
</tr>
<tr>
<td>April 26 – May 2</td>
<td>Report writing</td>
<td>Ambo PPRC</td>
<td>Team work</td>
</tr>
<tr>
<td>May 3-5</td>
<td>Preparation for final workshop, rewriting</td>
<td>Ambo PPRC</td>
<td>Team work</td>
</tr>
<tr>
<td>May 6</td>
<td>Final workshop</td>
<td>Ambo PPRC</td>
<td>Presentations and discussions</td>
</tr>
<tr>
<td>May 7-8</td>
<td>Finalizing the report</td>
<td>Ambo PPRC</td>
<td>Discussions and incorporation of comments</td>
</tr>
<tr>
<td>May 9</td>
<td>Departure to Nazret</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 2. Plan to collect primary data for the research questions

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Primary data needed</th>
<th>Methods</th>
<th>When</th>
<th>Who</th>
<th>Output</th>
</tr>
</thead>
</table>
| What is the cause of declining soil fertility? | • Soil properties  
• Major constraints and opportunities  
• Farmers perception indicators and strategy  
• System trend  
• Coping strategy | Field observation  
Interviews  
PRA (Transect walk, matrix ranking) | March 31 | Yimer Zerihun | Synthesize report and recommendation |
| What different agro-ecologies are found? | • Altitude  
• Crops  
• Rainfall  
• Topography  
• System trend | Field observation  
Interviews | March 20 | Tesfaye Getaneh | Zonation |
| How are the statues of forest and water resources? | • Constraints and opportunities  
• Farmers perceptions  
• System trend | Field observation  
Interviews  
PRA (resource mapping) | March 20 | Seneshaw Girma | Synthesize report and recommendation  
Causal relationship |
| How is the availability of improved varieties in BBSF? | • Types  
• Field perceptions  
• Availability  
• Constraints and opportunities | Field observation  
Interviews  
PRA (Matrix ranking, wealth ranking) | March 20 | Seneshaw Girma | Descriptions and recommendation  
Crop and cropping system  
Causal relationship |
| Which pests, diseases and weed sp. Affects the productivity of crops in BBSF? | • Pest diversity  
• Severity, damage  
• Crops affects  
• Constraints  
• Coping mechanism  
• System trend | Field observation  
Key informant  
PRA (matrix ranking, wealth ranking) | March 20 | Yimer Zerihun | Synthesize report and recommendation |
| What are the cultural practices and input use pattern of the farm community in Tikur Inchini | • Cultural practices  
• Crop calendar  
• Input use pattern | Field observation  
Key informant  
PRA (matrix ranking) | March 20 | Yimer Girma | Report crop calendar, and other practices |
| Which livestock type the farm community in Tikur Inchini year? | • Perception  
• Type nutrient  
• Management  
• Constraints and opportunities | Field observation  
Interview  
PRA (Matrix ranking) | March 20 | Tesfaye Yimer | Synthesize report and recommendation |
<table>
<thead>
<tr>
<th>Question</th>
<th>Topic/Method</th>
<th>Date</th>
<th>Authors</th>
<th>Additional Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>How influential feed shortage and diseases are to the availability of</td>
<td>Causes and time of feed shortage, farmers perceptions, trend, types of</td>
<td>March 20</td>
<td>Tesfaye Zerihun</td>
<td>Synthesize report and recommendation</td>
</tr>
<tr>
<td>draft power?</td>
<td>disease, severity, coping strategy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How is the crop-livestock interaction important in the BBF?</td>
<td>Draft power, manure, crop residue, trend, farmers perception, constraints</td>
<td>March 20</td>
<td>Girma Getaneh</td>
<td>Resource flow map, Synthesize report and recommendation</td>
</tr>
<tr>
<td>and opportunities?</td>
<td>and opportunities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How is the household composition by age and gender?</td>
<td>Family size, age, sex, household, gender: division of labor, access and</td>
<td>March 20</td>
<td>Girma Zerihun</td>
<td>Synthesize report and recommendation</td>
</tr>
<tr>
<td>constraints over resources, food habit</td>
<td>control over resources, food habit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How culture and religion influence productivity of BBF?</td>
<td>Perception, trend, constraints and opportunities</td>
<td>March 20</td>
<td>Yimer Seneshaw</td>
<td>Synthesize report and recommendation</td>
</tr>
<tr>
<td>How is the market, infrastructure and support services affect</td>
<td>No. of cultural and religious holidays, perceptions, trend</td>
<td>March 20</td>
<td>Yimer Getaneh</td>
<td>Synthesize report and recommendation</td>
</tr>
<tr>
<td>productivity of BBF?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How land tenure policy and farm size affect productivity of BBF?</td>
<td>Perceptions, trend, opportunities</td>
<td>March 20</td>
<td>Girma Tesfaye</td>
<td>Synthesize report and recommendation</td>
</tr>
<tr>
<td>How communal resource ownership influences productivity of BBF?</td>
<td>Land holding, perceptions</td>
<td>March 20</td>
<td>Girma Yimer</td>
<td>Report on policy, Effect and implications</td>
</tr>
<tr>
<td>How and with whom they are inter-related?</td>
<td>Farmers and stakeholders r/p</td>
<td>March 20</td>
<td>Seneshaw Tesfaye</td>
<td>Linkage map</td>
</tr>
</tbody>
</table>
Appendix 3. Focused Checklists

Enset wilt
- What are the host ranges of enset wilt? Do farmers have knowledge on the incidence of wilt disease on weeds?
- Which period of the year/month favors the incidence of enset wilt? Why?
- How is the response of enset cultivars to wilt disease? Are there resistant/tolerant cultivars of enset to the disease?
- How is the cutting process of enset? NB: Bacterial wilt is transmitted mechanically.
- Wheat cultural practices do farmers use to overcome wilt disease?

Chaffer grub
- How important is chaffer grub in the area? Which crops are severely affected?
- How sporadic is the pest? At which month of the year is chaffer grub damage critical?
- What factors induce the increment of chaffer grub population?
- Which soil type aggravates the incidence of chaffer grub?
- How is the response of chaffer grub to addition of fertilizer?
- How is the response of crop/varieties to chaffer grub damage?
- At which stage of the crop is chaffer grub damage critical?
- Is following burning of soil and crop rotation helpful in reducing the insect population?
- What are the coping strategies of farmers to chaffer grub?
- How effective are the coping strategies? Why do farmers’ coping mechanisms fail to control effectively?
- Do farmers use chemical pesticides? If so, which insecticide?
- Which natural enemies suppress the population of chaffer grub in the area?

Rust
- At which stage of the crop is rust damage most critical?
- How is the crop/varieties response (i.e. susceptibility, tolerance or resistance) towards rust disease?
- Which period/month of the year favors rust incidence? Why?
- What is the farmers’ perception to the host ranges of rust disease?
- What cultural practices do farmers use to overcome rust disease?

Soils fertility decline
- What are the constraints of different soils?
- What are the potentials of different soils?
- What are the major causes for fertility decline on different soils?
- Which areas of soils are more exposed fertility decline?
- Which farmers’ group are most affected by soil problem? Why?
- What are the various coping mechanisms by different farmer groups to improve soil fertility?

- Rich =
- Medium =
- Poor =
- Women =

90
What are the major problems to adopt and expand organic farming?

- "Ciibsaa"
- "FYM/Dikie"
- "Crop rotation"
- "Fall and wing"
- "Inter cropping"
- "Green manure"
- "Agroforestry"

What are the rate of adoption in fertilizer use?

What are the impacts of fertilizer use on different soils/crops?

What are the major constraints in fertilizer use and promotion?

What are the major causes for soil erosion?

What must be done to improve

- soil fertility
- control erosion
- expand soil conservation and by whom?

What are the different stakeholders who are participating or have potential in improving soil fertility and develop soil conservation?

What are the available technologies for soil fertility, erosion control and soil conservation?

How is the knowledge and information system in this sector (fertility, erosion, conservation, etc.)?

Indicate policy, development, research, socio-economic issues to improve soil fertility, control erosion and promote soil conservation in the area?

Feed shortage

- What type of animal is severely affected by feed shortage?
- Do you stall-feed? When? How and why not more?
- What are the types of grasses used for pasture? When do you use them?
- What are the types of grasses, which are more selectable by the animals. For what purpose do you use (pasture or hay)
- Is there any indigenous tree of which its leaves used for animal feed? When?
- What are the selected types of crop residues by animals and farmers? Why? When? How many times do you feed your animals per day with crop residues? How is the trend of crop residue utilization over the past two decades?
- For how many months of the year do you have enough feed for your animals?
- For how many months and days of the year do you feed your animals on:
  - pasture
  - crop residues
  - hay
  - enset leaves and its by-products
- What are the main causes of feed shortage in the village or PA? What is the farmers coping mechanism during critical feed shortage?
- Do farmers use fallow land for forage production? How is the trend for the past 20 to 30 years?
- What is the effect of feed shortage (death, weight loss, inefficient draft power, bloating, diseases susceptibility)?
- For which animal types do you give priority to feed the available feed during critical feed shortage/land preparation/planting? Why?
- When do you have enough forage for your oxen to plough efficiently? For how many hours do you use oxen to plough continuously per day?
- How is the palatability of *Pennistum shemperi* grass at various stages of growth?
- Do you burn the pastureland? Why? When? How is the trend over time?
- What are the main sources of water for your animals? How many hours the animals travel to get water per day?
- Why there is a flow of animals to your communal grazing land from neighboring woreda and PA? How many times and at what growth stage of *migiraa* grass, they come per year? What is its advantage and disadvantage?

**AKIS**

**A. Crop pests**

**Diseases (Enset wilt, Rust)**

- What alternatives were generated by research to control enset wilt and/or rust?
- Are there any on-going research activities to alleviate the above mentioned problems?
- What are the type of innovation available to control diseases?
- Who are the stakeholders in the area? Their roles?
- How is the linkage among the actors (weak/strong)?

**Chaffer Grub**

- What alternatives were generated by research to control chuffer grub?
- Are there any on-going research activities to alleviate problems due to chuffer grub?
- Type of innovation available to control chuffer grub?
- Who are the stakeholders in the area? their roles?
- How is the linkage among the actors (weak/strong)?

**B. Soil fertility decline**

- What alternatives were generated by research to reduce declining soil fertility?
- Are there any on-going research activities to alleviate problems of soil fertility?
- Type of innovation available to control declining soil fertility?
- Who are the stakeholders in the area? their roles?
- How is the linkage among the actors (weak/strong)?

**C. Feed shortage**

- What alternatives were generated by research to reduce feed shortage?
- Are there any on-going research activities to alleviate problems of feed shortage?
- Type of innovation available to control feed shortage?
- Who are the stakeholders in the area? their roles?
- How is the linkage among the actors (weak/strong)?