# CHAPTER 4

# CASE STUDY AREA, SURVEY DESIGN, AND SELECTED SOCIO-ECONOMIC CHARACTERISTICS OF THE SAMPLE HOUSEHOLDS

## 4.1 Introduction

This study was conducted in Meta and Babile districts in East Hararghe Zone of Oromia Regional State in the eastern Ethiopian highlands. These districts were chosen for the study mainly based on availability of strong intervention (research and extension) programs embracing smallholder food grains producers and representativeness of distinct (wet highland and dry land) agro-climatic zones typical of most smallholder farming conditions in eastern Ethiopia. Meta and Babile districts adequately represent distinct agro-climatic zones for the analysis of efficiency of food production across agro-climatic zones. The New Extension Program is actively implemented in view of the importance of food grains production in these districts as opposed to many other districts where cash crop production especially khat[3] cultivation dominates, and competes with, the production of food crops.

In this chapter, an overview of the nature of the farming systems in the Hararghe highlands in general and in the case study areas in particular is given. The survey design, including sampling, sample size determination, data collection, and selected household and farm characteristics of the sample households are also presented and discussed.

## 4.2 The Hararghe Highlands

The Hararghe area is situated in the eastern part of Ethiopia, 200 to 400 kilometers (km) east of the capital city Addis Ababa, some 300 km south of Djibouti and 250 km west of Hargeisa towns. In the sub-regional context (Djibouti, Northwest Somalia, & East Ethiopia), Hararghe is the only highland area with adequate climatic conditions for rain-fed agriculture and a reasonably well developed transportation network by road, rail, and air. Hararghe thus enjoys

[3] Khat (*Catha edulis*) is a perennial bush the leaves of which are chewed as stimulants. It is also the leading cash crop in East and West Hararghe (Storck et al., 1991, 1997).

a privileged position for food and cash crop production and marketing, with the trading potential still exceeding the actual production capacity.

The agro-climatic range includes lowland (*kolla*, 30-40 percent), midland (*weyna dega*, 35-45 percent) and highland areas (*dega*, 15-20 percent), with lowest elevations at around 1,000 meters above sea level (masl), culminating at 3,405 meters (m), at the top of Gara Muleta mountain. There are two rainy seasons and these are the short (*belg*) and the main (*meher*) seasons. Production during the *belg* season is limited within the *dega* zone and part of the wetter *weyna dega*, but *belg* rains are widely used for land preparation and seeding of long-cycle *meher* crops (sorghum & maize). Annual rainfall averages range from below 700 millimeters (mm) for the lower *kolla* to nearly 1,200 mm for the higher elevations of *weyna dega* and *dega* zones. The variability of rainfall from year to year and its uneven distribution during the growing seasons causes a wide range of climatic hazards which farmers have to deal with.

The main food staples include sorghum, maize, and sweet potatoes. Sweet potatoes are extensively cultivated during bad years to improve food security. Other food crops include barley, wheat, tef, and pulses. Cash crops like khat (a popular mild narcotic) and coffee have a long-standing tradition, complemented by Irish potatoes, onions/shallots and some other vegetables. They are mainly cultivated in the *weyna dega* zone, with some extension into the lower *dega* and exceptionally into *kolla* zones. The eastern lowlands such as Babile and to some extent the southern lowlands grow groundnut as a cash crop. Some twenty years ago, the lowlands of Mieso produced sesame, but their cultivation has stopped for climatic (and eventually economic) reasons, even though sesame is more tolerant to aridity than groundnuts. Climatic hazards are increasingly frequent in Hararghe, with pest infestations and crop diseases additionally hampering crop production

Increasing population density coupled with the lack of alternative employment opportunities leads to progressive land pressure and subsequent shrinking of individual landholdings. Likewise, arable land has to be used intensively, leaving practically no room for fallowing (Storck et al., 1997). Under actual conditions, crop rotation and fallow are no longer practiced and are rather dictated by climatic hazards. During a bad year, fallow will increase, especially in the lowlands, whereas the crops to be planted on individual plots will have to be chosen according to moisture availability and expected length of growing period. In this context, short cycle crops increasingly gain importance.

According to CSA (1997), 44 percent of farmers have landholdings not exceeding 0.5 hectares (ha) and 82 percent of farmers with landholdings less than 1 ha. Even if the accuracy of available data is questionable, they nevertheless reveal the actual trend where farmers' main capital besides labor and arable land is reaching a critical stage of fragmentation. The prevalence of extreme land pressure has already resulted in vast deforestation and the cultivation of unsuitable slopes in the highlands and midlands, causing severe environmental damage. In addition, considering the fact that with a population growth rate of around 3 percent, farm units are expected to double approximately every 20 years, future prospects in agriculture look very bleak.

The situation is further complicated by the multitude of very diverse farming systems, as practically every farmer follows his/her individual farm management strategy in terms of physical and human inputs and crop varieties. As a common trend, especially in *weyna dega* zones, taking advantage of the specific geographical situation, farmers respond to the worsening situation by progressively increasing their cash crop production in order to improve the performance of their farms in terms of cash value. The subsequent progressive shortage of staple food is made up for by the supply of cereals originating from neighboring surplus-producing areas of Arsi, Bale, and to a lesser extent East Shoa.

Farming systems in the eastern highlands consist of a number of interdependent cropping and livestock activities and they are strongly influenced by the respective natural and economic environment. They are to be described in terms of resource endowment, market orientation, major activities and location. Resource endowment is indicated by size and factor relations (intensity); major activities concern cropping pattern and crop rotations as well as animal husbandry; market orientation relates to the share of production for subsistence and cash; and location is determined by agro-climatic conditions, distance to markets and other indicators of the socio-economic environment (Storck et al., 1991).

Moreover, the farming systems in the eastern highlands of Ethiopia constitute complex production units involving a diversity of mixed crops and livestock in order to meet the multiple objectives of the household (Bezabih and Storck, 1992). The main features of the farming systems in the eastern highlands are summarized in Table 4.1. It is observed that land scarcity prevails in the region with land-labor ratios decreasing with altitude. Cropping patterns change with altitude though large cereals generally play an important role and intercropping is widely practiced. As the focus of this study is on food crops, the large cereals zones were selected. These included areas with altitudes ranging from 1300-2600 masl.

Table 4.1: Indicators of the farming systems in East Hararghe Zone

| Altitude range (masl) | Land/labor (ha/ME*) | Livestock Unit (LU) | Share of cultivated area (percent) | | | | Intercropping index (percent) |
|---|---|---|---|---|---|---|---|
| | | | Coffee | Large cereals | Pulse | Oil crops | |
| 1301-1700 | 1.36 | 3.64 | 0.8 | 68 | 0 | 9.8 | 37 |
| 1701-2200 | 0.8 | 2.73 | 1.4 | 67 | 1 | 0.3 | 45 |
| 2201-2600 | 0.56 | 1.47 | 0.3 | 50 | 0 | 0.5 | 25 |
| Total | 0.94 | 2.92 | 1.1 | 66 | 1 | 3.1 | 41 |

Note: ME = man equivalents

Source: Bezabih and Storck (1992).

## 4.3 Description of the Case Study Areas

The study areas, Babile and Meta districts, are located in East Hararghe Zone (Map 4C) in the eastern Highlands of Ethiopia. Oromia is one of the Regional States of Ethiopia (Map 4A) and East Hararghe is one of its administrative zones (Map 4B). Meta is located in eastern Oromia at about 435 km from Addis Ababa and 90 km west of Alemaya University. The average altitude is about 2000 masl and the length of growing period (LGP) lies between 240 and 300 days (Storck et al., 1991). Babile is located in eastern Oromia at about 555 km east of Addis Ababa and 50 km east of Alemaya University. The average altitude is about 1650 masl with small variations among the PAs in the district and the LGP lies between 150 and 210 days. The area is mainly characterized by an erratic rainfall pattern, which fluctuates heavily from year to year making cropping vulnerable to drought. The average annual rainfall in Babile ranges between 500 mm and 875 mm with much variation among different years (Figure 4.1).

The average amount falls below the national average rainfall, which varies roughly between 600 mm and 1000 mm per year (Storck et al., 1997; Bezabih, 2000). Figure 4.1 shows that, over the last four years, annual rainfall has been steadily decreasing in Babile. Rainfall being the single most important factor dictating food production in the area, this could largely explain the growing food shortages in the area over the last couple of years. Meta district, on the other hand, receives relatively higher amount of annual rainfall ranging between 900 mm and 1200 mm. Meta, as opposed to Babile, is thus considered a high potential food crop production zone and NEP is widely implemented to enhance the production of cereals, including maize, wheat, and barley.

Therefore, the two districts were purposely selected for this study to represent widely differing agricultural production conditions where Babile is highly fragile and some intervention programs are underway to revert the situation, and Meta represents a high potential production zone but with high population pressure causing excessive fragmentation of farmland. In the study areas, cultivation of annual and perennial crops and rearing of livestock are the common farming activities. The major crops grown in Babile include sorghum, maize, and groundnut while maize, wheat, and barley are the dominant crops in Meta.

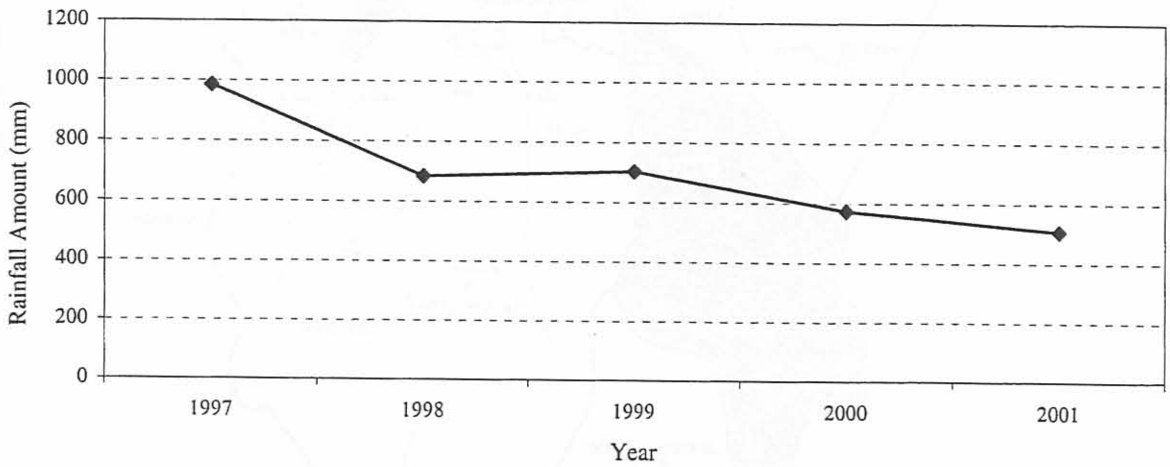


Figure 4.2: Amount of annual rainfall in Babile.
Source: Computed from Babile Weather Station data, Alemaya University.

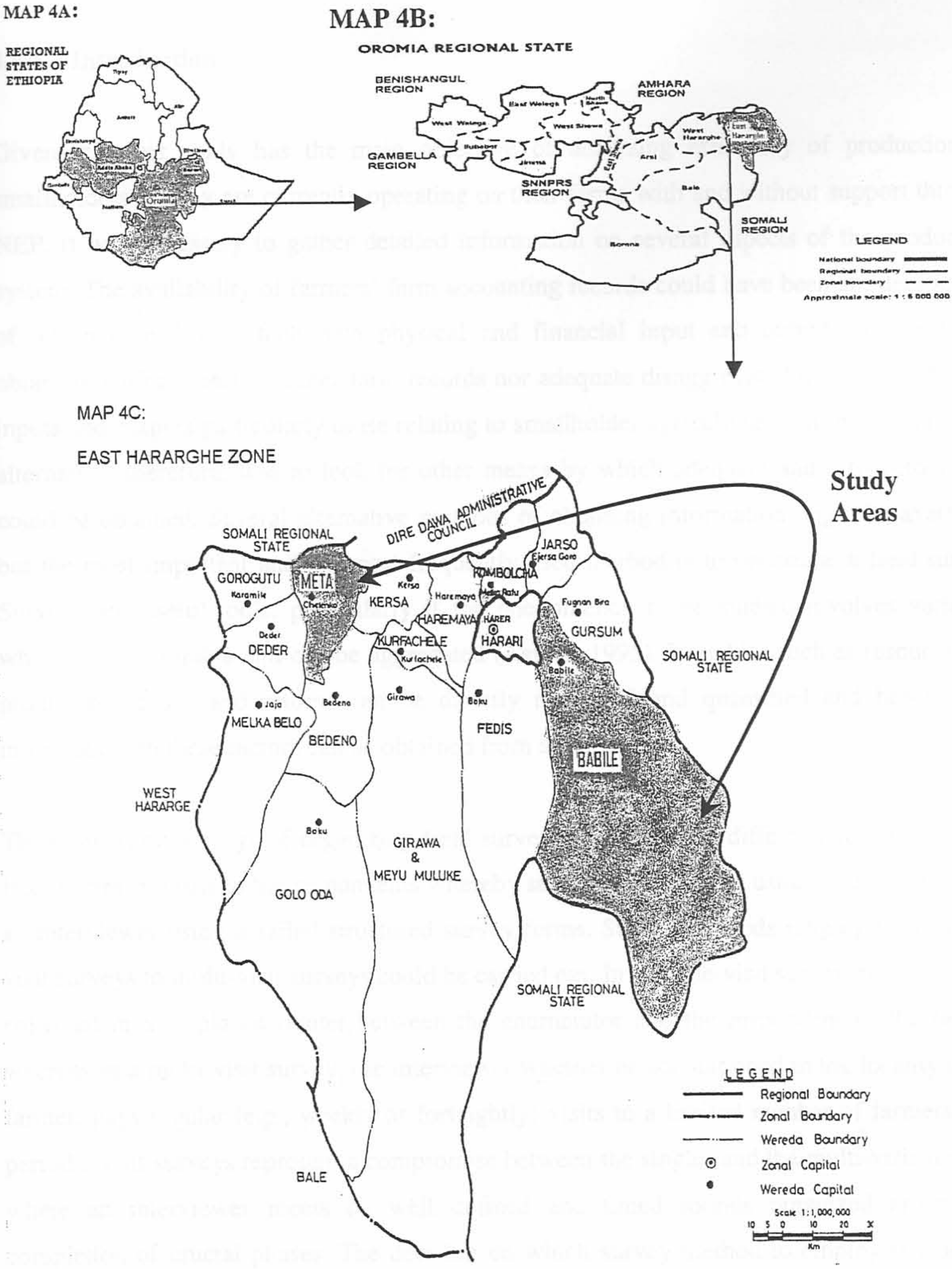


Figure 4.1: Maps of Oromia region and East Hararghe Zone.

## 4.4 Sample Design and Data Collection

### 4.4.1 Introduction

Given that this study has the main objective of analyzing efficiency of production of smallholders as they are currently operating on their farms with and without support through NEP, it was necessary to gather detailed information on several aspects of the production system. The availability of farmers' farm accounting records could have been an ideal source of information from which both physical and financial input and output data could be obtained. Unfortunately, neither farm records nor adequate disaggregated time series data on inputs and outputs particularly those relating to smallholder agriculture exist in Ethiopia. The alternative, therefore, was to look for other means by which adequate and satisfactory data could be obtained. Several alternative methods of obtaining information might be available, but the most important and the most frequently used method is to undertake a field survey. Surveys are useful tools, particularly if the phenomenon to be studied involves variables which are measurable and can be aggregated (Assefa, 1995). Variables such as resource use, production, costs, and returns can be directly measured and quantified and hence basic information on these factors can be obtained from a field survey.

There are various ways of organizing field surveys, each method differentiated by different frequencies in visits to the respondents whereby sets of questions are usually administered by an interviewer using detailed structured survey forms. Survey methods ranging from single-visit surveys to multi-visit surveys could be carried out. In a single-visit survey, information is collected in a single encounter between the enumerator and the respondent or the farmer, whereas in a multi visit survey, the interviewer whether or not stationed in the locality of the farmer, pays regular (e.g., weekly or fortnightly) visits to a limited number of farmers. The periodic visit surveys represent a compromise between the single- and the multi-visit surveys, where an interviewer meets on well defined and timed rounds organized around the completion of crucial phases. The decision on which survey method to employ is made by considering the trade-offs between quality of data needed and the costs of the information needed. In this particular study, the multi-period or periodic visit field survey has been used to generate the necessary information for the intended analysis.

### 4.4.2 Sampling and Sample Size Determination

Given the general scarcity of resources, conducting a census in which every individual farmer is directly approached is not possible and this forces us to employ sample surveys. In order to draw valid inferences from the sample and to ascertain the degree of accuracy of the results, the sample need to be drawn following the laws of probability. The appropriateness of a sampling method thus depends on how it will successfully meet study objectives. This study followed a multi-stage sampling procedure in selecting farmers to be surveyed throughout the agricultural year.

The first stage involved a purposeful selection of East Hararghe Zone from eastern Ethiopian highlands based on availability of strong intervention (research and extension) programs embracing smallholder food grains producers and availability of distinct (wet highland and dry land) agro-climatic zones representing most smallholder farming conditions in eastern Ethiopia. The second stage involved purposeful selection of the two study areas, Babile and Meta districts, based on their adequate representation of distinct agro-climatic zones for the analysis of efficiency of food production across agro-climatic zones. Moreover, NEP is well underway in view of the importance of food grains production in these districts as opposed to many other districts where cash crop production especially khat cultivation dominates, and competes with, the production of food crops.

Meta district was selected to represent a typical highland (2500 masl) where there is very high population pressure on land and receives relatively better rainfall amount and distribution ranging between 900 and 1200 mm per annum. Meta is a high potential production zone and NEP is widely implemented to enhance the production of food grains and to promote soil conservation practices. On the other hand, Babile district was selected to represent a low moisture zone receiving an annual rainfall between 500 and 875 mm and has got an average altitude of 1650 masl. Babile is an important target of NEP and several non-governmental organizations (NGOs) in view of widespread food insecurity in the area. Dry land technologies generated by Alemaya University and other research centers are mainly tested and promoted in Babile. Technologies include short-cycle, drought-tolerant, and better-yielding varieties of maize and sorghum along with the appropriate fertilizer recommendations and agronomic practices.

Farmers in the study area are organized into PAs, the lowest administrative units consisting of 80 to 300 farm households residing in villages adjacent to one another (Storck et al., 1991). In this study, because of the need to adequately control for the influence of environmental factors, that cannot be captured through surveys, on the efficiency of farmers, not only did this require homogenous PAs to be selected but also their number had to be limited to minimize heterogeneity. Therefore, three homogenous PAs were selected from each district and the farm households in each PA were stratified into participants and non-participants based on whether a household was participating in NEP during the 2001/2002 cropping season or not. The list of PAs in each district was obtained from the district agricultural offices and the list of PA members was obtained from the district finance offices. Based on the list of the PA members in the three selected PAs, the agricultural offices in the respective districts prepared two sampling frames, one each for participants and non-participants in NEP.

Sample size determination as appropriate for a particular study is usually a difficult exercise in any research work. Theoretically, the sample size is determined by the pre-assigned level of accuracy of the estimates of the mean of the parameters. This, however, requires knowledge about the degree of variability of a large number of parameters, all having different degrees of variability. This knowledge rarely exists prior to the study. In practice, therefore, sample size is most often determined by considerations of financial constraints and availability and adequacy of other resources such as trained manpower and time (Assefa, 1995). Because of the complexity of data requirements and financial and time constraints, sample sizes are usually small and cannot be expected to produce highly reliable estimates for all parameters. Nevertheless, it is possible to improve this situation by stratifying the population into many sub-populations based on one or more classification variables.

Taking these issues into consideration, a total of 100 farm households were selected from each district. Based on the sampling frames prepared for each PA, a total of 50 farm households were randomly selected from each group of participants and non-participants, proportional to PA size, to represent the respective agricultural technologies, making the sample in each district 100 farm households (Table 4.2). However, 3 farmers in Meta who were originally non-participants later joined the program and this increased the sample of participants in Meta to 53 and decreased the sample of non-participants to 47.

Table 4.2: Sample farm households by district and PA

| PA | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| | Participants | Non-participants | Total sample | Participants | Non-participants | Total sample |
| Burqa Jalala | 26 | 20 | 46 | - | - | - |
| Caffee Aneni | 13 | 13 | 26 | - | - | - |
| Utuba Muti | 14 | 14 | 28 | - | - | - |
| Kito | - | - | - | 19 | 19 | 38 |
| Sirbaa | - | - | - | 14 | 14 | 28 |
| Wayuu | - | - | - | 17 | 17 | 34 |
| TOTAL | 50 | 50 | 100 | 53 | 47 | 100 |

Source: Own survey.

### 4.4.3 Data Collection

Development of a structured and detailed questionnaire was an important step in data collection. The questionnaire was designed based on three major farm operations in the area: land preparation and planting, weeding, and harvesting. Therefore, separate questionnaires pertaining to each agricultural operation were designed and pre-tested through a pilot survey to ensure clarity, adequacy, and sequencing of the questions. The questionnaires were designed in such a way that they provide adequate input-output data which would enable assessment of the production efficiency of smallholder farmers. Based on the results of the pilot survey, the questionnaire sets were revised and finalized. Actual data collection was also preceded by selection of appropriate enumerators for the year-round survey (February 2001 – January 2003) who were already living and working with the farmers. The selected enumerators received an intensive training on the objectives, contents, and methods of the survey.

Data collection took place during the 2001/2002 agricultural year through frequent visits to the sample households to carry out interviews using the structured questionnaires relating to resource use and management and productivity of the various enterprises. Farmers' crop fields were also regularly visited to take plot level measurements and observations throughout the cropping season. Input data were collected on a fortnight basis by asking the farmer to recall his/her activities during the past two weeks. Data included the quantities of seed and fertilizer used, labor time disaggregated by source, gender, age, and field operation and other miscellaneous inputs. The prices of all purchased inputs were also collected during this time. Output data on all the quantities of cereals, pulses, and oil crops harvested were also collected. A separate survey was conducted to collect output price information from Muti, Chelenko, and Babile markets during planting and harvesting times of the major crops. Data on the farm households' socio-economic characteristics were also collected during the survey.

There were three major data collection phases depending on the major farm operations in the study areas. The first round was soon after land preparation and planting of major crops in the respective districts. The second and third rounds were conducted after weeding and harvesting of major crops, respectively. The existence of two rainy seasons in Meta and the consequent need for repeating the three phases in both seasons for the respective crops was a daunting task. Although land preparation and planting of maize and sorghum takes place following the onset of the short (or *belg*) rains in March/April, the other farm operations such as weeding and harvesting are extended over their long growing season until they are harvested in January/February. On the other hand, there are also the so-called *belg* crops such as potatoes and barley which have to be planted following the short rains in April and harvested before the onset of the long rains starting June/July to release land for the long-rain (or *meher*) crops such as wheat, barley, and tef. Data collection thus required six rounds of surveys in Meta as opposed to 3 rounds in Babile in view of the prevalence of two cropping seasons in Meta.

## 4.5 Household and Farm Characteristics in the Study Areas

### 4.5.1 Family Size and Age Structure

In view of the extended family system in Ethiopia, several members of a family live together and take part in the social and economic activities of the household. Table 4.3 depicts family structure and labor force in the study areas. In Meta, family size ranges from 1 to 11 persons with an average of 5 persons per household.

In Babile, on the other hand, this ranges from 1 to 14 persons with an average of 6 persons per household. Owing to polygamous marriage and lack of family planning, farm households in the study areas have a large number of children who are less than 14 years and cannot significantly contribute to the family labor. This is clearly demonstrated by the lower man equivalent (ME), that proxies family labor supply, than the corresponding adult equivalent (ADE), that takes the subsistence requirements into account, both in Babile and Meta (see Appendix A4.1 and A4.2 for the conversion factors used to compute ME and ADE, respectively).

Table 4.3: Family structure and labor force of the sample farmers (mean)

| Characteristics | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| Family size | 6 | 5 | 5 | 6.5 | 6 | 6 |
| Age | 38 | 40 | 40 | 37 | 38 | 38 |
| Adult equivalent | 3 | 2.86 | 3 | 3.50 | 3.27 | 3.39 |
| Labor force | 1.58 | 1.39 | 1.49 | 1.57 | 1.45 | 1.50 |

Source: Own survey.

Table 4.3 shows that only 1.49 out of the 3 ADE in Meta can provide labor force in ME and actively engage in an economic activity, indicating that 50 percent of the family members depend on this active labor force for subsistence. This dependency is relatively higher in the case of non-participants (52 percent) than that of participants (47 percent), indicating the availability of higher supply of labor among participants. In Babile, only 1.5 out of the 3.39 ADE can provide labor force and actively engage in an economic activity, indicating that 56 percent of the family members depend on this active labor force for subsistence. This shows that there is higher dependency in Babile compared with that in Meta. Unlike in Meta, this dependency is similar among participant and non-participant farm households (56 percent), indicating comparable supply of labor across the farm groups. Moreover, in both areas, participant farmers have higher family size.

### 4.5.2 Education

Education is considered an important factor determining the efficiency with which farmers use their available resources and technology. Low level of education is typical in developing countries such as Ethiopia. Table 4.4 presents the education status of sample farmers in the study areas. Table 4.4 shows that 28 percent of the sample farmers in Meta and 46.5 percent of the sample farmers in Babile are illiterate, indicating relatively better educational status in Meta. Alternatively, 72 percent and 53.5 percent of the sample farmers in Meta and Babile, respectively, can at least read and write. It is also shown that there is a big difference between participant and non-participant farmers in terms of educational status. Table 4.4 shows 22.6 percent and 34 percent of the participant and non-participant farmers in Meta, respectively, are illiterates. In Babile, on the other hand, 34 percent and 59 percent of the participant and non-participant farmers, respectively, are illiterates. Alternatively, while about 78 percent of the participants in Meta can at least read and write, only 66 percent of the non-participants can read and write. In Babile, while 66 percent of the participants can at least read and write, only 40 percent of the non-participants can read and write. In both areas, this indicates higher educational status among farmers participating in NEP.

Table 4.4: Education status of the sample farmers (percent)

| | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| Characteristics | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| Illiterate | 22.6 | 34.0 | 28.0 | 34.0 | 59.2 | 46.5 |
| Read and write | 45.3 | 48.9 | 47.0 | 30.0 | 24.5 | 27.3 |
| Primary education | 22.6 | 12.8 | 18.0 | 34.0 | 14.3 | 24.2 |
| Secondary education | 9.4 | 4.3 | 7.0 | 2.0 | 2.0 | 2.0 |

Source: Own survey.

### 4.5.3 Land Resources

Availability of productive land is a means of survival for the vast majority of the rural population. In rural areas of Ethiopia, land and labor account for the largest share of agricultural inputs. Capital inputs such as farm implements, oxen power, seeds and fertilizer are essential but constitute a marginal share of the total cost of production. Thus, the amount of land available for a household may determine the amount of production and hence its livelihood. The survey revealed that farm size ranges from 0.19 to 1.69 ha with an average of

0.69 ha in Meta and from 0.15 to 4.13 ha with an average of 1.57 ha per household in Babile (Table 4.5).

In the study areas, participants are better endowed with land compared with the non-participant farmers. In Meta, participants cultivated relatively larger area (0.73 ha) than the non-participants (0.65 ha). In Babile, participants also cultivated larger area (1.70 ha) than the non-participants (1.45 ha), where 32 percent of the participants cultivated more than 2 hectares of land. Generally, in view of the growing population pressure, availability of farmland per household seems to have dwindled over the years. For example, average cultivated land in Babile was 2.40 ha in 1993/1994 (Storck et al., 1997) and this decreased to 1.87 ha in 1996/97 (Bezabih, 2000) and is again reduced to 1.57 ha in 2001/2002 as revealed in this study.

Table 4.5: Distribution of the sample farmers by farm size (percent)

| Farm size (ha) | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| <0.5 | 26.4 | 43.5 | 34.3 | - | - | - |
| 0.5 - 0.99 | 56.6 | 43.5 | 50.5 | 12.0 | 20.0 | 16.0 |
| 1 - 1.49 | 9.4 | 13.0 | 11.1 | 30.0 | 38.0 | 34.0 |
| 1.5 - 1.99 | 7.5 | 100.0 | 4.0 | 26.0 | 24.0 | 25.0 |
| ≥2 | - | - | - | 32.0 | 18.0 | 25.0 |
| Average (ha) | 0.73 | 0.65 | 0.69 | 1.70 | 1.45 | 1.57 |

Source: Own survey.

Land shortage seems to be more serious in the wet highland zone (Meta) than in the dry land zone (Babile). About 34 percent of the sample households in Meta and no sample household in Babile cultivated less than 0.5 ha. By farm groups, about 43.5 percent of the non-participant farmers and 26.4 percent of the participants in Meta cultivated less than half a hectare, indicating that a considerable proportion of the non-participant farmers were highly constrained with land. Farmers with serious land shortages have not benefited much from extension services in Ethiopia mainly due to their inability and unwillingness to allocate a portion of their land to 'experiment' with new technologies out of their already small and economically unviable plots.

In fact, the SG project in the past required a farmer to allocate half a hectare plot for demonstration of new varieties, fertilizer, improved cultural practices, and other technologies which means many of the sample farmers in this study would not qualify. This may still be a constraint under NEP in some of the regions although it has been relaxed in others with a view to reaching as many small farmers as possible. For example, the fact that about 26.4 percent of the participant sample farmers cultivated less than half a hectare clearly confirms that the size of demonstration plots has been further reduced from half a hectare. Actually, a farmer in Meta is required to allocate a quarter of a hectare of land for the application of improved technologies such as improved seeds and fertilizer and this plot is known as an extension plot.

### 4.5.4 Livestock Ownership

Livestock constitute an important component of the farming systems both in the highlands and lowlands of Ethiopia. Livestock production provides home consumable or saleable products like meat, milk, egg, manure, and fuel. Livestock products are also an integral part of the diet of the farm households. In addition to this, an important contribution of livestock particularly that of oxen is the provision of draught power for the cultivation, threshing, and transportation of grains and crop residues. Farmers also regard livestock to be a more reliable capital investment and store of wealth. They can be easily transformed into liquid assets in areas where no institutional credit facilities exist. However, the productivity of cattle in Ethiopia in terms of milk and meat output has been very low because of low genetic potential and inadequate nutrition. The seasonal variability in the quality and quantity of animal feed gives rise to an annual cyclical pattern of live weight gains and losses. In any case, the Ethiopian farmer would like to own some livestock in spite of the low productivity. In fact, farmers try to have more but less productive livestock than few but more productive livestock showing their primary interest in herd size as opposed to productivity.

In the study areas, the sample farmers rear different kinds of animals in order to produce animal products and also to generate income both enhancing the household's access to food. The animals include cattle, sheep, goats, donkeys, camels, and chicken. Small ruminants and chicken are reared, respectively, for meat and egg production both for consumption and for sale. In the event of serious food shortage, small ruminants and chicken are the first to be sold to meet the household's food demand. Based on Storck et al. (1991, p.188), the herd size was converted into Livestock Units (see Appendix A4.3 for conversion rules) to make comparison of livestock ownership across the farm household groups possible. Table 4.6 presents livestock ownership by farm household groups.

There is a noticeable variation across the study areas and between the farm groups. In view of the growing pressure on land in Meta and the consequent conversion of previously grazing lands into farmland for crop production, livestock production seems to have declined. For example, 4.5 percent and 35 percent of the sample households in Meta and Babile, respectively, have more than 5 LU. While no household owns more than 10 LU in Meta, 7.2 percent of the sample households in Babile own livestock in excess of 10 LU. On average, the sample households in Meta own 2.3 LU while the sample households in Babile have an average livestock holding size of 4.78.

Analysis of livestock holding by farm groups reveals that participant farmers in both study areas have greater holdings. Participant farmers in Meta have a higher average livestock holding (2.52 LU) than the non-participants (2.04 LU). Similarly, participants in Babile have higher average livestock holding (5.67 LU) than the non-participant farmers (3.9 LU). Further, none of the non-participant households and 7.7 percent of the participant households own livestock higher than 5 LU.

Table 4.6: Livestock holding of the sample households

| LU range | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| <2 | 42.3 | 51.4 | 46.1 | 12.5 | 18.4 | 15.5 |
| 2.01 - 4.99 | 50.0 | 48.6 | 49.4 | 39.6 | 59.2 | 49.5 |
| 5 - 9.99 | 7.7 | - | 4.5 | 37.5 | 18.4 | 27.8 |
| >10 | - | - | - | 10.4 | 4.1 | 7.2 |
| Average | 2.52 | 2.04 | 2.30 | 5.67 | 3.9 | 4.78 |

Source: Own survey.

The availability of animal draught power is an important factor in crop production in the Ethiopian highlands. The number of oxen owned by a farmer determines the area cultivated, influences the cropping pattern and has a serious impact on total production. In the study areas, smallholder farming systems are traditional and managed with simple production technology. Land preparation is done by traditional rudimentary farm implements like oxen-drawn ploughs, hoe, *Akkafa* (traditional spade), and *Dongora* (an iron tipped stick with stone at the top end). Farm machinery are absent in the area. As oxen shortage is severe, manual labor supply is very important for land preparation and subsequent cultivation during the cropping season. Significant delays in timely and proper land preparation and sowing are heavily influenced by oxen shortage. Conventionally, land preparation is done with the help of a pair of oxen. The survey revealed that in Meta 11 percent of the farmers have no working oxen, 64 percent have one ox, 23 percent have two oxen, and 2 percent have four or more oxen (Table 4.7).

In Babile, on the other hand, only 3 percent of the farmers have no working oxen, 13 percent have one ox, 56 percent have two oxen, 15 percent have three oxen and 13 percent have four or more oxen. This confirms the serious shortage of oxen power in the wet highland zones such as Meta producing large cereals (maize and sorghum) and small cereals (wheat, barley, and tef) compared with the dry land zones such as Babile producing largely sorghum and groundnuts.

Table 4.7: Distribution of oxen among the sample households

| | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| Status | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| No oxen | 11.0 | 21.3 | 11.0 | 4.0 | 2.0 | 3.0 |
| One ox | 64.0 | 61.7 | 64.0 | 8.0 | 18.0 | 13.0 |
| Two oxen | 23.0 | 14.9 | 23.0 | 50.0 | 62.0 | 56.0 |
| Three oxen | - | - | - | 16.0 | 14.0 | 15.0 |
| four oxen or more | 2.0 | 2.1 | 2.0 | 22.0 | 4.0 | 13.0 |

Source: Own survey.

In both study areas, the non-participant farmers seem to be more constrained with draught power than the participants. In Meta, for example, 75 percent and 83 percent of the participants and non-participants, respectively, have only a single ox or no oxen at all.

Similarly, in Babile, 12 percent and 20 percent of the participants and non-participants, respectively, have only a single ox or no oxen at all. Farmers with only one ox or without an ox for draught power sometimes share with friends or relatives. Availability and capacity of oxen influences the cropping system especially in the wet highland zone of Meta. Farmers with less than a pair of oxen usually prefer to cultivate pulses such as beans rather than small cereals such as wheat and tef since the latter demand high oxen power for land preparation.

Unfortunately, the prevalence of small cereals production in the wet highland zone that require high draught power does not mean farmers have higher oxen holdings compared with the farmers in the dry land zone. Because of the fact that crop production and livestock production are highly competitive in the wet highland zone due to the growing shortage of grazing lands, the farmers in the wet highland zone keep a rather smaller number of livestock including oxen. In fact, because land is greatly diminishing over the years due to growing population pressure, farmers may have little or no reason to keep more oxen for draught power purposes if they have adequate labor force for hoe cultivation.

However, the shortage of both oxen power and labor force and the consequent delays in farm operations may pose problems for farmers to make use of the existing inadequate and uneven distribution of rainfall with the result that yields are substantially reduced. Therefore, farmers without oxen and relatively low labor supply have to reduce the number of plowing rounds before sowing crops. The undesirable consequences of a reduced number of plowing rounds on yield are obvious as this reduces water penetration into the soils and increases weed infestation. Farmers in the study areas turn over soils with *Dongora* during the dry season to overcome the labor shortage and facilitate a breakdown of soil particles. Cultivation is done 2 to 4 times per cropping season depending upon the availability of labor and rainfall conditions. In fact, cultivation goes together with weeding and thinning. The major cultivation activities to be undertaken are two: *Hagayii* (first cultivation) and *Ka'abaa* (second cultivation). The first cultivation is aimed at reduction of plant density (or thinning) and weed infestation control. First cultivation for sorghum and maize is sometimes done with oxen plough in seasons with relatively favorable rainfall and known as *Baq-baqaa*. The second cultivation is accomplished using traditional spade (*Akkafa)* aiming at root system development of the crops by heaping soils to the root and stem of the plant.

### 4.5.5 Labor Utilization

The smallholder farmers in the eastern highlands, like in any other subsistence oriented farming system, rely heavily on household labor supply to carry out the domestic social, economic and other activities. Labor use in a rain-fed agricultural system is usually characterized by seasonality. The work schedule is dictated by the calendar of farm operations in the year. Consequently, during peak production seasons particularly during harvesting and weeding seasons there exist labor shortages and non-family labor or extra labor has to be used. Labor shortages during peak periods constitute one of the major constraints to agricultural production in Ethiopia.

In the study areas, the family constitutes one of the main sources of labor supply for farming. Hired labor is less common. Exchange labor (or *Guzza)*, however, constitutes another source of labor in the study areas. This is a practice where a farmer requests a group of farmers (friends and/or relatives) to come together and work for him/her in the event of peak labor requirements. The farmer is, however, required to prepare *hodja* (boiled coffee with or without milk) and khat for that day. Family and exchange labor are thus the major sources of human labor in the study areas. The proportion of hired labor in the total human labor input was only 7 percent in Meta and 11 percent in Babile. About 65 percent and 28 percent of the labor force requirements for crop production in Meta were met, respectively, from family and exchange labor (Table 4.8). Similarly, about 68 percent and 21 percent of the labor demands in Babile were met, respectively, through family and exchange labor arrangements.

A comparison of farm household groups in Table 4.8 clearly shows that participant farmers in both districts applied more labor input than the non-participants probably due to their relatively higher cultivated land as presented in Table 4.4. Participants in Meta used a greater proportion of family labor (79 percent) and hired labor (11 percent) compared with the non-participants who used 49 percent family labor and only 3 percent hired labor. However, non-participants in Meta also used higher proportion of exchange labor (38 percent) than the participants who used only 20 percent exchange labor, showing the dependence of non-participant farmers on exchange labor in addition to own family labor. In Babile, on the other hand, participant farmers used a greater proportion of family labor (74 percent) but less exchange labor (18 percent) and hired labor (8 percent) compared with the non-participants who used 60 percent family labor, 25 percent exchange labor and 15 percent hired labor. This also shows the dependence of non-participant farmers on external labor (i.e., both exchange and hired labor) in addition to own family labor.

Another important aspect of labor utilization is the allocation of total labor inputs for the various crops and cropping systems characterizing the farming systems in the study areas. Labor input applied to most of the cropping operations benefit the whole plot in a cropping system. As far as sole cropping is concerned, labor input can be attributed to the requirement of the crop grown. But in the case of intercropping, most of the operations favor the whole system and the input cannot be broken down by crop components of the system. Harvesting labor input is applied for individual crops in a cropping system and this information is therefore related to one specific crop.

Table 4.8: Distribution of labor use by source (man-days)

| Source | Meta | | | Babile | | |
|---|---|---|---|---|---|---|
| | Participants | Non-participants | All sample | Participants | Non-participants | All sample |
| Family labor | 1981.5 (79) | 995.5 (49) | 2977 (65) | 3574.2 (74) | 2253.4 (60) | 5827.6 (68) |
| Exchange labor | 502.8 (20) | 779.6 (38) | 1282.4 (28) | 869.4 (18) | 930.3 (25) | 1799.7 (21) |
| Hired labor | 260.7 (11) | 59.9 (3) | 320.6 (7) | 386.4 (8) | 556.3 (15) | 942.7 (11) |
| Total | 2510 (100) | 2070 (100) | 4580 (100) | 4830 (100) | 3740 (100) | 8570 (100) |

Note: Figures in parentheses are percentages.

Source: Own survey.

Table 4.9 presents the total labor input per hectare for the major cropping systems in the study areas. It is shown that labor input varies across cropping systems and locations. Labor inputs per hectare of the major cropping systems were generally lower in Babile than in Meta. This does not mean, however, that total labor inputs were lower in Babile. Rather, because the cultivated area of land allocated to each of these cropping systems in Meta was generally less than half a hectare, a per hectare labor input calculation could be misleading in that it overestimates actual labor inputs. Therefore, this at best shows how congested labor use is in Meta in view of the extremely small plots cultivated by the sample farm households coupled with the high supply of family and exchange labor in the absence of alternative employment opportunities. Nevertheless, it is also important to note that the crop growing period in the wet highland zone is so long compared with the dry land zone that it could have considerable implications for labor use and could thus provide part of the explanation. Further, because Meta receives better amount of annual rainfall than Babile, such cropping operations as weeding and cultivation require more labor due to more vigorous weed growth and infestation. Total labor input has been broken down by the three major cropping operations, including land preparation and planting, weeding and cultivation, and harvesting according to which the data were collected during the survey. Cropping systems including groundnuts, which are found only in Babile, do not require much more labor than cereals but the labor input for harvesting was quite substantial. Average labor input for each cropping operation is generally different and the differences are less consistent.

In Babile, while the system with haricot beans and large cereals such as maize and sorghum requires the highest per hectare labor input (78 man-days/ha), the system with groundnut requires the least (36 man-days/ha). Improved maize grown as a sole crop in Babile also requires high labor inputs (77 man-days/ha) the greatest share of which is needed for weeding and cultivation (34 man-days/ha). In Meta, while the system with maize and potatoes requires the highest amount of labor input (89-105 man-days/ha), most of which is required for weeding and cultivation, the system with local maize and local sorghum requires the least amount of labor (49 man-days/ha). Moreover, small cereals such as wheat, tef, and barley also require modest amounts of labor input (81-87 man-days/ha) but higher than the requirements of pulses and the system with khat and local large cereals.

Table 4.9: Per hectare labor input for the major cropping systems (man-days/ha)

| Cropping system | Meta | | | | Babile | | | |
|---|---|---|---|---|---|---|---|---|
| | Land preparation and planting | Weeding and Cultivation | Harvesting | Total | Land preparation and planting | Weeding and Cultivation | Harvesting | Total |
| Groundnut | - | - | - | - | 13 | 16 | 39 | 68 |
| Groundnut/Local Sorghum | - | - | - | - | 9 | 12 | 15 | 36 |
| Local maize/Local sorghum | 13 | 21 | 15 | 49 | 11 | 16 | 12 | 39 |
| Local sorghum | 28 | 29 | 18 | 75 | 21 | 24 | 19 | 64 |
| Local maize | 26 | 30 | 28 | 84 | 19 | 27 | 22 | 68 |
| Improved maize | 31 | 38 | 23 | 92 | 22 | 34 | 21 | 77 |
| Khat/local maize | 20 | 32 | 10 | 62 | 19 | 28 | 8 | 45 |
| Haricot beans/Local maize/Local sorghum | 24 | 29 | 32 | 85 | 19 | 23 | 36 | 78 |
| Barley | 31 | 20 | 28 | 81 | - | - | - | - |
| Tef | 36 | 30 | 21 | 87 | - | - | - | - |
| Potatoes | 37 | 39 | 23 | 99 | - | - | - | - |
| Beans | 22 | 18 | 17 | 57 | - | - | - | - |
| Wheat | 30 | 28 | 27 | 85 | - | - | - | - |
| Improved maize/Potatoes | 34 | 38 | 33 | 105 | - | - | - | - |
| Khat/Local maize/Potatoes | 32 | 35 | 29 | 96 | - | - | - | - |
| Local maize/Potatoes | 29 | 32 | 28 | 89 | - | - | - | - |

Source: Own survey.