Report on the 2003 Joint Baseline Survey in the Targeted Areas of the PL480, Title II Program in Ethiopia

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June 2004

This publication was made possible through the support provided to the Food and Nutrition Technical Assistance (FANTA) Project by USAID/Addis Ababa and USAID's Office of Health, Infectious Disease and Nutrition of the Bureau of Global Health under terms of Cooperative Agreement No. HRN-A-00-98-00046-00 awarded to the Academy for Educational Development (AED). The opinions expressed herein are those of the author(s) and do not necessarily reflect the views of the U.S. Agency for International Development.

Recommended citation:

Bergeron, Gilles, Megan Deitchler, and John Pender. *Report on the 2003 Joint Baseline Survey in the Targeted Areas of the PL480, Title II Programs in Ethiopia.* Washington, D.C.: Food and Nutrition Techical Assistance (FANTA) Project, Academy for Educational Development (AED), 2004.

Copies of the publication can be obtained from:

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ACKNOWLEDGEMENTS

The 2003 Ethiopia Joint Baseline Survey and the preparation of this report would not have been possible without the critical support of several people, both in Ethiopia and in Washington. The authors particularly wish to acknowledge the members of the Supervision Committee of the Joint Baseline Survey who played an essential role in making the process not only possible but enjoyable. The members of this Committee included Mulugeta Tefera, of CARE/Ethiopia and Maria Strinzos, of REST who coordinated different aspects of the survey on behalf of the Title II Cooperating Sponsors; Solomon Bezabet, of CRS/Ethiopia; Tolesa Nuru, of World Vision; and Wondimo Zike of SC/US. The work was also greatly facilitated by the unconditional support provided all along by Tim Shortley and Beth Dunford of USAID/Addis. Makeda Tsegaye of USAID/Addis played an instrumental role in facilitating USAID funding for this exercise. To all of you, for the time, patience and intellectual support you provided throughout the process, we are deeply thankful.

Several sectoral specialists in each of the Cooperating Sponsors and at USAID/Addis also lent their knowledge and experience to the design of the survey and the interpretation of the results. Specifically we wish to acknowledge the help of Dennis Latimer and Hazel Simpson, at CRS; Mulu, at Save the Children/US; Salvador Baldizon at CARE; Kassahun Belay, Metsilal Abraha and Makonen Ashenafi at USAID/Addis.

Consultants that contributed to the survey include AGRIDEV who provided first class support as Team Leader for data collection, and who went out of their way to provide a clean database. Samson Dejene, a statistician working with AGRIDEV provided excellent backup during the data analsys process. Irwin Shorr provided superb training to enumerators in anthropometric measurements.

In Washington, several persons also contributed their insights to this undertaking. We particularly wish to thank Bruce Cogill, Anne Swindale, Annette Sheckler, Ryan Goldman and Heather Finegan of the FANTA project, and Eunyong Chung of USAID, for their unwavering support throughout the process. Our most sincere gratitude goes to all of you.

ACRONYMS

AEZ	Agro Ecological Zone
AG/NRM	Agriculture/Natural Resources Management
BCC	Behavior Change Communication
BSS	Behavioral Surveillance Survey
CA	Cooperative Agreement
CARE	Cooperative for Aid and Relief Everywhere
CBO	Community Based Organization
CRS	Catholic Relief Services
CS	Cooperating Sponsor
DAP	Development Activity Proposal
DHS	Demographic and Health Survey
FANTA	Food and Nutrition Technical Assistance Project
FAO	Food and Agriculture Organization
FHI	Family Health International
HAZ	Height for Age Z-score
HH	Household
KAP	Knowledge, Attitude, Practice
Kcal	Kilo-calorie
KPC	Knowledge, Practices Communication
LQAS	Lot Quality Assurance Sampling
M&E	Monitoring and Evaluation
MCHN	Maternal and Child Health and Nutrition
MUAC	Middle Upper Arm Circumference
NCHS	National Center for Health Statistics
NGO	Non Governmental Organization
NRM	Natural Resources Management
OLS	Ordinary Least Square
ORS	Oral Rehydration Salts
PAHO	Pan American Health Organization
PL-480	Public Law 480
PPS	Probability Proportional to Scale
PTA	Parent Teacher Association
PVO	Private Voluntary Organization
REST	Relief Society of Tigray
SC/US	Save the Children/United States
SES	Socio Economic Status
SPSS	Statistical Package for the Social Sciences
TBA	Trained Birth Attendant
T-II	Title II
TLU	Tropical Livestock Unit
TT	Tetanus Toxoid
USAID	United States Agency for International Development
WAZ	Weight for Age Z-score
WHO	World Health Organization

WHZ	Weight for Height Zscore
WVE	World Vision Ethiopia

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EXECUTIVE SUMMARY

Introduction

Since 1997, the US government in collaboration with several international NGOs has supported a number of food security projects in Ethiopia using PL-480, Title II resources. The second cycle (2003-2007) of food security Development Activity Programs (DAPs) is implemented by five Cooperating Sponsors (CSs): CARE, Catholic Relief Services (CRS), the Relief Society of Tigray (REST), Save the Children-US (SC/US) and World Vision (WV). All those DAPs are multisectoral, including among others health, nutrition, agriculture, natural resource management and HIV/AIDS activities. Services are provided to populations that live in some of the most food insecure *woredas* of Ethiopia, principally in Amhara, Oromia, Tigray and SNNPR.

When beginning a new program Title II Cooperating Sponsors (CSs) must conduct a baseline survey to assess the conditions in target areas before activities begin. This provides a basis against which the progress made by a DAP towards fulfilling its objectives can be assessed at the end of the project. The present report examines the results from the baseline survey conducted jointly by the five CSs in their targeted areas between May and August 2003 as a prelude to their new 2003-2007 programs. The report also provides recommendations for adjusting the program to the conditions documented by the survey. The findings and recommendations provided here have statistical validity for the Title II-targeted areas only. They should not be extrapolated to other areas.

Methodology

This is the first survey in a pre/post evaluation sequence. The evaluation model uses a plausibility design (see Annex 1). Sampling was devised to allow for both historical and internal controls at the final evaluation stage, with the same localities but different cross sections of households being surveyed at each point. The sample size was calculated so the project could reliably demonstrate whether or not it had reached its targeted reduction of 7 percentage points in stunting level among children 6-60 months over the life of the project. A classic cluster sampling approach was used with villages as primary sampling units, households as secondary units, and children in the 6-60 months age-range as tertiary units. Opportunistic sampling was also used to collect nutrition and health information from children 0-6 months of age. Information on a total of 429 children of 6-60 months of age was required per CS area. The cluster design factorial was set at 30X31 (thirty villages, with thirty one households in each) to yield 930 households per CS area, for a total of 4650 across the whole sample. The final number of interviews conducted is 4636, well within the security margins built into the sampling design.

Indicators collected by this survey reflect the multi-sectoral nature of the DAPs. Questionnaires were designed following a modular format to accommodate between-CSs differences. Three main sectors (health and nutrition, agricultural production/natural resources management, and HIV/AIDS) were emphasized in the questionnaires. For each of those, data was collected on outcomes and covariates, the latter being identified using a conceptual framework specifying the hypothesized determinants of targeted outcomes.

Community information was also collected, using a focus group methodology. At the household level, female heads in sampled units were asked to respond to the household demographic and health survey; while male heads were the main respondent for questions related to agriculture and natural resources management. Males and females were also asked independently questions about their income generating activities and about HIV/AIDS. Lastly, the caregivers for the reference children were identified and asked questions about their child's health and nutrition (including anthropometry for children 0-60 months of age), feeding practices used, as well as various issues surrounding the neonatal/postnatal conditions surrounding the birth of that child.

The survey period fell at the tail end of the 2002-2003 drought, which affected the Northern, Central and Eastern portions of the country. This drought is described as one of the worst on record, its severity surpassing even the 1984 drought, which caused more than one million deaths. The high fatality rates of 1984 were however avoided in 2002-2003, thanks to a well concerted and generous response from the international community. Nonetheless the crisis had far-reaching effects on the livelihoods of most people in our sample, stretching everyone's coping capacity beyond its limits. As a result several of the findings and relationships documented here are, we believe, atypical: people's coping mechanisms were so affected that the buffer usually conferred by higher income, better education or a larger asset base were annihilated, leaving all equally exposed to destitution. This situation made our analysis more complex, as described in the report. It will also complicate the comparison between the Baseline and Final Evaluation data.

Community and Household Characteristics

A total of 151 localities dispersed across 130 Peasant Associations (PAs) were visited, 94% of them in the rural highland. Populations were found to be isolated and to have poor access to basic health, transport, commercial services and supplies. About half of the villages are only accessible by foot, and another third only via seasonal roads.

One in every four household is headed by a female. Housing conditions are simple and poor. Due to differences in climatic conditions and in the availability of raw materials, there are notable variations between regions in housing construction; yet most everywhere, the average home has a floor made of dirt, sand or stone; walls built from mud or stones; and a roof made of thatch or stalks. Less than 1% of units have electricity; 3% have an appropriate latrine, and less than 4% have access to a protected water source.

Occupations mainly revolve around agriculture, with livestock rearing being an important component of the predominantly mixed farming systems of the Highlands. Herding is also the central strategy in pastoralist areas of the South. Aside from those, the economy is not much diversified: market sales are practiced by many households but the quantities marketed are very small and rarely appear to constitute a central element of the household economy. Other activities such as wage labor, trading, handicrafts and value added processing do not appear important either, although they may provide an essential complement when households operate at survival level.

To understand the distribution of wealth across units, and to create functional groups for analysis, a factor analysis was performed using the household's tools, livestock and land assets. Bivariate analyses factoring in that wealth index showed that women headed households consistently classify among the poorest units; that larger families tend to be wealthier (suggesting the importance of access to family labor); and that the wealthier the household, the more likely it is to have access to a latrine, to a protected water source and to practice safe garbage disposal. Additional analyses are presented in the report on the relationship between household wealth and its agricultural performance, as well as the health and nutrition of its members.

Household Agricultural Performance

All five CSs operate agricultural extension programs. The central goal of their interventions is to increase the performance of farming by sustainably improving the levels of crop output. The indicators used to represent farming output are yields, and total production. Each points at different aspects of performance, yields being viewed as an expression of farming efficiency while total production per capita (once converted into a common yardstick such as monetary value or kilocalories) is viewed as more indicative of household food security as it links the nutritional and economic needs of a farming household to its output.

Our conceptual model presents agricultural performance as a function of three classes of factors, namely: 1) land characteristics; 2) farm characteristics; and 3) institutional and economic context. In turn:

1) Land characteristics refer to the quality and quantity of the land available to the producer, the productive investments made and farming practices used on that land, as well as exogenous factors related to the agroecology (rainfall, etc).
2) Farm characteristics include household wealth, access to family labor, farm size, technical knowledge and education of the farmer and gender of the family head
3) The institutional/economic context, finally, refers to the input and output markets, access to productive capital, means of transport and access to information.

A large number of crops were mentioned by farmers in our sample yet only a few of them are grown widely, and those are generally cereal crops (maize, wheat, teff, barley, sorghum, beans, and lentils). Few cash crops are found, and they are generally locally specific (e.g. chat, coffee, sugarcane). Yields for main cereal crops were found in our sample to be well below their theoretical potential (defined as yields of a crop grown under experimental station conditions). The Yield Gap Ratio (current yield divided by potential yield) varies between crops, but farmers never reach more than a third of the potential of their crops, with wheat performing the lowest (20% of potential). Reducing this yield gap is a primary concern of CSs' agricultural extension programs.

The total output produced by the farm is also low and household production is generally insufficient to sustain farming households. To reach this conclusion, total quantities of food produced (both crops and animal source foods) were converted into kilocalories (Kcal) equivalent and then compared to the yearly Kcal needs of the household. Results show that the

overwhelming majority of households are unable to satisfy their yearly Kcal needs out of their own production. On average, households in our sample produce only 37% of their yearly needs. Half of all households (the median) produce less than 23.5 percent of those needs and only 5.5% meet all their Kcal requirements from their own production. An alternate way of representing this point is to look at the number of months of food reserve available to the household. 87.5% of farmers say they do not produce enough food for their family to last twelve months, with households stating that they have enough food for an average of 4.5 months of the year. Those findings closely conform to those presented using Kcal equivalents.

Another analysis was performed to examine the theoretical capacity of farms to supply their food needs, assuming they manage to attain optimal potential yields on all crops. This shows that, even if farmers replicated the yields obtained in experimental stations over all of their cultivated fields (an unlikely possibility), 35% of them would still be unable to fulfill their kcal requirements from their own production. Land is an absolute constraint for at least a third of the farms. Those various results show the seriousness of the food security situation confronting the farming households in our sample: self provisioning is an unattainable goal for most of them. Diversifying their income is the only way to secure their access to food. This does not suggest abandoning agriculture as a programming sector, but it implies that in those areas, focusing on agriculture alone to improve food access will not be sufficient.

Determinants of Agricultural Performance

The low production levels highlighted above have to be understood in the context of the various determinants of agricultural performance in the areas where the CSs operate. The next step in our analysis looks at the most important of those determinants, namely, the quality and quantity of land available to farmers, the socio economic characteristics of the farm, and economic/institutional factors. The findings we report in this summary come mainly from the econometric analysis of individual crop yields (Chapter 10). Chapter 9 contains additional description of the conditions of production.

Findings indicate that cereal production in our sample is constrained by land quality (associated with plot size), use of key inputs, farmers' technical knowledge, presence of CBO, and cattle ownership. Constraints on households' labor supply and managerial capacity also appear to be important. All these findings are robust and are consistent with our hypotheses. Other factors that had mixed impacts included the number of contacts with extension services; the importance of pastoralism in the area; and land tenure. It is notable that irrigation was not found to significantly affect yields of major cereal crops (it may affect higher value crops such as vegetables but this was not captured as we examined only the effect of irrigation on cereal crops). This lack of effect may relate to the limited availability of water during that year's drought; yet this finding is not unique and has been reported by research done in Ethiopia at different time periods.

Survey findings suggest several potential areas of intervention to promote increased cereal production in the study regions. Development of CBOs to provide agricultural training appears to be a promising approach, though more research is needed to understand how and why CBOs are having such positive impacts. As already suggested, broadening of the approach to include

other livelihood strategies and technologies beyond the past emphasis on promoting mainly improved cereal varieties and fertilizer appears to be needed, as is a more farmer-centered approach. Also, farmers need more crop and location specific information regarding fertilizer and other technology recommendations, access to appropriate types of fertilizer suited to local needs (rather than universal application of DAP and urea), and training in proper methods of using fertilizer and other inputs. Addressing these problems could facilitate more productive and profitable use of fertilizer and other inputs.

Improved land management technologies such as check dams, soil bunds, reduced burning and use of manure appear to offer potential for increased production of some crops in some contexts. Such practices may work best when coupled with the use of fertilizer, improved seeds, irrigation, and stone terraces. These synergies have not been adequately studied, however and it is critical that research and technical assistance programs attempt to understand and exploit such potential synergies and recognize the location and crop-dependence of the technologies and land management approaches being promoted. Top-down, "one-size-fits-all" approaches to technical assistance do not work well in the diverse circumstances of Ethiopia.

Our findings appear less promising regarding the impacts of most land investments, but particularly stone terraces and irrigation, both of which are widely promoted in drought prone areas of Ethiopia. Our findings on stone terraces are in contrast to those of other studies; while the findings of other studies on the impacts of irrigation are mixed. Overall, however, these findings suggest that strong positive impacts of such investments is not a foregone conclusion. This should not be taken as proving that they cannot or do not have positive impacts: here again, more focused research on the costs and impacts of such investments, under different biophysical and socioeconomic environments, is needed to draw definitive conclusions.

The importance of oxen draft power in cereal production, together with the limited impact of oxen ownership on yields, suggests that oxen lease and sharing arrangements and/or land rental and sharing arrangements work fairly well to overcome shortages of oxen draft power relative to the farmer's operated land area. This result concurs with other research conducted in the Arsi region.

Despite the large amount of rhetoric on the land tenure issue in Ethiopia, our results (and other studies) suggest that the issue may be overblown, at least as regards factors affecting cereal production. We do not find strong and consistent impacts of different land tenure arrangements on cereal yields. This is consistent with findings reported in other research. Other issues appear to be more critical to increasing cereal production in Ethiopia.

Our findings suggest that liquidity constraints may be binding for Ethiopian farmers, affecting their ability to purchase cattle, inputs and tools. Development of micro-finance savings and credit institutions can help farmers to overcome such constraints. One particular need is longer-term credit, as it is difficult for farmers to repay loans for large items such as a cow within one year, which is the usual limit on loan duration. It is also important to emphasize the potentially vital role of offering farmers profitable and secure financial savings opportunities. Most Ethiopian farmers use livestock as their main form of savings, which can be very risky in

drought-prone environments, since livestock often die or lose much of their value during and after droughts.

Our findings suggest that increasing opportunities for education and off-farm employment, while critical for addressing poverty, may cause trade-offs in terms of reduced production of cereals and other crops. This does not mean that such opportunities should not be promoted and pursued. The goal is to reduce poverty and food insecurity, and not simply to increase cereal crop production, and the longer term potential for achieving this goal certainly requires continued improvement in education and off-farm employment. Nevertheless, recognition of the potential negative impacts that progress in these areas can have on agricultural production in the near term can contribute to effective efforts to address the constraints and opportunities arising from this. In cereal deficit areas, the demand for food imports is likely to continue to increase and shift towards more income elastic commodities such as livestock products, vegetables, etc. as education and off farm development increase incomes and reduce food production further. This will increase opportunities for programs to promote production and marketing of such commodities, both in cereal surplus and cereal deficit areas. Cereal surplus areas will find opportunities to produce feed supplies for growing livestock industries (e.g., dairy and livestock) as the demand develops, provided that investments in education and off-farm development continue to improve both rural and urban incomes. The efforts of non-governmental private voluntary organizations can be critical in helping to promote continuing development in this direction.

Maternal and Child Health and Nutrition

Section 4 examines the health and nutrition of children and the factors hypothesized to affect their nutritional status. The UNICEF conceptual framework, used to guide our analyses, identifies three underlying causes of malnutrition: 1) Inadequate dietary intake; 2) Inadequate environment, including poor water and sanitation and insufficient health services; and 3) Inadequate care. The model suggests an interactive relationship between inadequate dietary intake and the presence of infection and disease: disease or illnesses lead to poor nutrient utilization, eventually causing nutrient deficiency or depletion. Conversely, inadequate dietary intake does not provide sufficient nutrients for proper immune functions, increasing the risk of disease. Care practices affect how health and diet are provided to the child, thereby affecting those outcomes. The relationship between poor caretaking behaviors, insufficient dietary intake, poor nutrient utilization, and/or frequent episodes of infection and disease, is what generates malnutrition.

Child Nutritional Status

Our review begins with an examination of the nutritional status of children in our sample. Overall, the extent of malnutrition deteriorates until about two years of age, after which it remains relatively constant. The average prevalence of stunting, wasting, and underweight for children 6-60 months is 34.6, 12.4, and 40.4 percent, respectively. Those figures vary by age group, however: among children 30-36 months, the prevalence of stunting and underweight is close to fifty percent, and among children 9-24 months, wasting rates are above 15%, a level often used to trigger an emergency response. Taken together, these anthropometric data provide critical information for the targeting of food security, nutrition, and health interventions. Specifically, the data imply that the greatest impact of interventions aimed at preventing malnutrition may be obtained by targeting children under 24 months of age, and caregiver practices related to children of this age.

Child Food Intake

We next examine the diet of children and the dietary practices used by their caretakers. Our review is informed by the international guidelines proposed by PAHO/ WHO, LINKAGES and UNICEF, who recommend several key actions to ensure the adequate nutrition of infant and young children. Among those infant and child feeding guidelines are:

1. Children be exclusively breastfed from birth up until six months of age.
2. Breastfeeding be initiated within one hour of delivery
3. Nutrient-rich colostrum be fed to the infant.
4. Children 6-24 months be offered breast milk frequently and on-demand.
5. Caretaker develop good hygiene and proper food handling techniques
6. Caretaker avoid the use of feeding bottles.
7. Caretaker provide complementary foods in addition to breast milk starting at 6mo.
8. Caretaker increase the number of daily complementary feeds and the quantity of food provided at each feed as the child grows older. For the average healthy breastfed infant, meals of complementary foods should be provided two to three times per day for children 6-9 months of age and three to four times per day for children 9-12 months and 12-24 months.
9. Nutritious snacks be offered to children 6-24 months 1-2 times per day as desired.
10. Caretaker provide a varied diet to the child once complementary feeding is initiated. Meat, poultry, fish or eggs should be eaten daily, or as often as possible. Vitamin A rich fruit and vegetables should be eaten daily, and adequate lipid content should be included in the child's diet. (PAHO/WHO 2003, LINKAGES 2002).

Our data show that Ethiopian mothers already display several positive practices when compared to those guidelines. First, breastfeeding is widespread in our sample. Nearly all children receive breast milk for the full first year, and almost 70 percent of children still receive breast milk at 24 months. In addition, nearly three quarters of mothers feed nutrient rich colostrum to their child, and most mothers initiate breastfeeding on the day of delivery. Those are all positive practices that should be recognized and encouraged.

Despite these positive practices, there are several areas that call for programmatic action. Although breastfeeding is common, exclusive breastfeeding is not widely practiced in our sample: less than one in three children 0-6 months are exclusively breastfed. Conversely, the use of liquids and/or foods other than breast milk is common among children of that age group. Further, it is noted that the use of feeding bottles is somewhat frequent, particularly for children 6-12 months. The initiation of breastfeeding is also delayed, as only one in five mothers initiate breastfeeding within one hour of delivery. Equally worrisome, the frequency of complementary feeding was insufficient for all age groups of children, but appears most problematic for younger children: 63% of children 6-9 months received no semi solid or solid foods during the previous day. The proportion is also high at 39% for children 9-12 months. This may relate to the high rates of continued breastfeeding after 6 months: mothers may believe that semi solid and solid foods are not necessary until twelve months or beyond. This is a critical area for behavior change.

With regards to dietary diversity, our data show that children in the Title II program area have poor quality diets, with few minerals and nutrients included. The majority of children in all age groups receive less than two food categories per day. Cereal is generally provided to every age group of children but other food categories are rarely included: no more than ten percent of children under 12 months were reported to have received any other food than cereals in the previous day. The lack of dietary diversity among children of all ages requires attention. The percent of children receiving key food categories such as meat, eggs, and fruits and vegetables rich in vitamin A should be higher for every age group of children in our sample.

Those findings indicate a number of recommendations to improve the diet of children. Mainly, caretaker behavioral change is required in relation to:

- exclusive breastfeeding throughout the first six months of life;
- the initiation of breastfeeding less than one hour after delivery
- the frequency of complementary feeds among children 12-24 months; and
- the variety of food groups offered to all children
- the intake of Vitamin A rich and animal source foods for all children.

Child Health

We next move to a discussion of the health of the children in our sample. As described in the UNICEF model, children's health and nutritional status are closely related. In the presence of infection and disease, appetite as well as the absorption and utilization of nutrients may diminish. Similarly, children who are malnourished are less resistant to illness, disease, and infection. Information on the status of children's health and practices related to child health are thus key, not just for the protection and promotion of child health in general, but also to gain an understanding of the specific conditions which cause and sustain child malnutrition in Ethiopia. The baseline survey collected data on the prevalence of sickness/disease (fever, cough, diarrhea) among children, as well as on the types of treatment sought by caretakers when children are ill. The data provide information on the extent to which recommended preventative (e.g. immunization, avoidance of harmful practices) and treatment practices are followed, and what remedial action may be taken to improve practices among caregivers.

Few children in Ethiopia are fully immunized by one year of age: Of those having a health card, only 15.2 percent of children 12-24 months have received the full course of recommended vaccinations, as documented by health card or by caregiver recall. This proportion *decreases* for older age groups: only 9.1 percent of children 24-36 months and 9.7 percent of children 36-60 months with a health card are fully immunized.

Survey data also indicate that the prevalence of night blindness among children in our sample is at 4.7 percent for children over 24 months. This is high by international standards. Yet no more than 27.8% of children have received Vitamin A supplements in the past, according to the health card or caregiver recall. Adequate intake of vitamin A rich food is the preferred method for preventing vitamin A deficiency but, as discussed above, the percent of children receiving vitamin A rich fruit and vegetables with regular frequency is negligible. Interventions for increasing household access to vitamin A rich fruit and vegetables are therefore recommended—from home gardening to supplementation, including nutritional counseling.

High rates of illness and disease were detected among children of all ages. Nearly half of children 6-60 months had been ill in the two weeks prior to data collection. Roughly 30% of them experienced multiple episodes of sickness (two or more) in that time period, with younger children (less than 12 months) showing even higher rates of infection that older children for the illnesses considered (cough, fever, diarrhea).

Of those children having experienced illness, about a third received any sort of treatment, and even fewer received appropriate care: for instance, the proportion receiving the full course of recommended treatment for diarrhea across all age groups is less than 1%. Part of the issue here is the knowledge of the caretaker, and their awareness of the existence of counseling resources. Our data also suggests that distance to drugs and medical services is an important factor in providing treatment. Thus, CS approach to improve caretaking of childhood illness should address both the poor availability of services and the gaps in caretaker knowledge.

Messages to caretakers should target the individuals who have the decision making role in seeking treatment for a sick child. For children 6-60 months, the mother or the father participate in decision making in more than 80 percent of the cases. The role of the grandmothers and siblings is also important, and increases with the age of the child as mothers' involvement correspondingly decreases. This age specificity of care-taking practices has important implications for the targeting of health-related messages.

Environmental sanitation also has important effects on child health. As we discussed earlier, access to potable water and adequate sanitation is limited for most households in Ethiopia—only 4% of households have access to a protected water source, and 3% to an adequate latrine. Still, the data indicate a fair amount of awareness about the importance of washing hands before preparing food and before feeding the child; about keeping the house clean; and about washing utensils. It is not clear, unfortunately, that this knowledge translates into appropriate practices: for instance, only 10 percent of caregivers demonstrated a correct hand washing technique. Also, few respondents mentioned washing hands after going to the toilet or after changing the child's diapers. Since the prevalence of diarrhea is associated with knowledge of methods for preventing

the illness, it seems that behavior change messages addressing the link between hygiene, particularly handwashing, and prevention of diarrhea would be important.

Those findings indicate a number of actions that may be taken by CSs to improve the health of children. Recommended areas of focus are summarized below:

- increase access to immunization services
- increase access to Vitamin A supplementation
- strengthen counseling in the comprehensive treatment of child illness across age groups, and in child feeding practices following episodes of sickness
- improve feeding practices following childhood diarrhea (and other episodes of sickness), specifically, the need to increase the amount of food provided to the child in order to facilitate catch-up growth
- target health messages to influential household members
- improve household access to adequate water and sanitation.

Childcare Practices

Child care, the last of the three underlying factors that determine nutritional status, is examined next. Care refers to those practices that support a child's need for sufficient and adequate food, health care, stimulation, and emotional support. Chapter Fourteen focuses particularly on the resources that support such caring behaviors.

The data show that ninety five percent of children 6 months to 5 years receive care primarily from their mother (curiously, that percentage is lower, at 81%, for children 0-6mo than among older children—a finding we have difficulty to explain). Among children 6-60 months the proportion declines progressively as the child ages from 98% in the 6-9 months to 93% in the 36-60 months age groups, with the grandmother, father, and siblings playing an increasingly influential role in providing childcare. It would therefore seem important that the other influential members of the household be also targeted for behavior change and child health and nutrition education messages.

The resources available to a mother significantly affect her capacity to provide care. Our results show that mothers who have a decision-making role in the household and mothers who are literate are more likely to continue breastfeeding their child after 6 months, to provide them with the recommended number of daily complementary feedings and to provide them with a varied diet. Also, those mothers are more likely to seek the correct treatment when their child is ill. Some of those relationships are found also among mothers who have only one young child to care for, and mothers who are head of household. Those findings illustrate, aside from their intrinsic value, the benefits for children of raising women's status and education, and of longer birth spacing.

Pre- and Postnatal Care Services

The examination of pre- and postnatal care services accessed by the mothers of sampled children suggests a low utilization of pre-natal services: only twenty percent of women had at least three pre-natal visits over the course of that pregnancy (although more than half of all women received

pre-natal care at some time in the ninth month of pregnancy). The importance of complying with guidelines in this area cannot be over-stressed: tetanus toxoid vaccination and iron supplementation are administered during those visits and adherence to recommended guidelines in those areas is strongly associated with the number of prenatal visits, as our data show. The data on delivery assistance and post-natal care also raise concerns. In less than twenty percent of cases was a trained health worker present at delivery. Further, only 7 percent of women had a post-natal visit following their delivery and only 16 percent of women received vitamin A supplements in the forty five days following the delivery. We also noted that women at first pregnancy are less likely to do their pre- and post natal visits than women in later pregnancies.

Several program implications can be identified following these findings. The importance of multiple pre natal visits, and the need for a trained health provider at delivery and post-natal care should be emphasized. CSs in Ethiopia should therefore continue to disseminate messages promoting the health benefits associated with these practices. Moreover, because our results suggest that women having already experienced pregnancy are more aware of the health benefits associated with preventative care/use of health services, Cooperating Sponsors might also consider how to better target women in their first pregnancy with health related information and messages.

In addition, mechanisms to facilitate women's adherence to recommended pre-and post-natal health practices are needed. Greater accessibility and outreach by the health system may be indicated. When designing relevant programmatic interventions, consideration should also be given to cultural norms surrounding the pregnancy and post-partum period and innovative approaches may be necessary to reach women during the pre-and post-partum period in certain regions.

Results of Regression Analysis on Child Health and Nutrition Outcomes

The last chapter of the MCHN section provides a multi-variate analysis of child health and nutrition outcomes. Two regression models are defined: 1) a OLS model to explain the outcome of child nutritional status for children 6-24 months, as indicated by height for age Z score and 2) a logistic regression model to explain the outcome of child diarrhea among children 6-60 months. The results from the models are similar, each showing factors related to four main thematic areas to have strong relation to the outcome of interest. Factors related to 1): household wealth; 2) women's status (education and control of resources); 2) water access (quantity rather than quality); 3) caregiver hygiene practices (particularly handwashing practices); and 4) infant and child feeding practices (particularly dietary diversity) are shown as most important. Also of note, having been a recipient of supplementary food aid significantly improved height for age performance.

These regression results identified several key areas for CS intervention. Again, the most important ones include (i) activities that raise women's status (practical skills-training, access to micro-credit income generating opportunities); (ii) infrastructure building to increase access to protected water and to improve sanitation around the home; (iii) behavior change practices addressing hygiene practices such as handwashing; and (iv) education and counseling in child feeding practices, particularly with regards to increasing the frequency of feeding and the diversity of children's diet. Our results confirmed that such activities have the potential to offer

substantial benefits, not only by reducing the prevalence of child diarrhea and stunting, but more generally, by improving the general health, nutrition, growth and development of children in Ethiopia.

HIV/AIDS

Ethiopia is currently experience a generalized HIV epidemic. The HIV sero- prevalence rate among adults in Ethiopia is currently estimated at around 6.6 percent. There are large variations across demographic groups, however, and the few studies that collected sero prevalence data from adult men and women in rural areas indicate a HIV prevalence of around 3.7 percent for rural populations. The primary mode of HIV transmission in Ethiopia is through heterosexual contact. As a result, sexually active adults are among the most frequently infected in Ethiopia, with current trends indicating an increasing proportion of young people becoming affected, likely due to unsafe sexual practices. Given this situation, it was recognized by the CSs that collecting data on the knowledge, attitudes and practices (KAPs) related to HIVS among DAP beneficiaries was essential to a comprehensive approach for addressing the HIV/AIDS pandemic in their intervention areas, and a special module was included in the survey forms to collect such information. Note that the forms did not include assessments of prevalence rates; it only considered KAPs. It is also important to mention that this data cannot be considered statistically representative, and the results are only presented for indicative purposes.

Few respondents report having had sex with commercial sex workers or non-regular partners over the last 12 months. Sex with a non regular partner or some other partner in the last 12 months was reported slightly more frequently and among those, roughly one in three men reported condom use with a commercial sex partner or with an "other" type of partner. About 15 percent of men and women reported condom use when having sex with a non-regular partner.

Knowledge of sexually transmitted infection is higher among men than women. There is a moderate level of awareness about HIV preventive methods, with about 2 in 5 persons of either sex being aware of the three major HIV preventive methods; but a high percent of men and women have misconceptions about possible means of transmission of HIV. For instance, most men and women believe HIV can be acquired through mosquito bites and many think that transmission can occur by sharing a meal with an HIV positive person. Moreover, 61.2 percent of women and 47.8 percent of men do not believe that a healthy looking person could be infected with HIV. Such misperceptions contribute to erroneous attitudes towards those that may be infected. Frequent stigmatizing attitudes include: an unwillingness to share a meal with an HIV positive person, a belief that people living with HIV/AIDS (PLWHA) should be quarantined, and an unwillingness to buy food from a shop keeper known to have HIV or to allow PLWHA to participate in community meetings and activities.

Among the men and women surveyed, almost all respondents are aware that mother to child transmission of HIV is possible. Most men and women know that a pregnant woman infected with HIV or AIDs can transmit the virus to her unborn child. In addition, the majority of men and women recognize breastfeeding is a possible mode of transmission. Fewer respondents, however, have knowledge about how to reduce mother to child transmission of HIV/AIDS and

many do not think that it is possible to reduce the risk for mother to child transmission of HIV during pregnancy.

Those findings lead us to recommend that Title II programs implement KAP messages about HIV/AIDS prevention methods and transmission modes. Educational campaigns to reduce stigmatizing attitudes and discrimination against HIV/AIDS are also strongly recommended. In addition, Cooperating Sponsors might consider strategies to improve access to voluntary counseling and testing in the Title II area. Our results indicated a high level of willingness to undergo voluntary counseling and testing (87.7% males, 84.1% females), yet few of these services are yet available in the Title II area.

General Recommendations

The analyses in this report provide several recommendations for the current DAPs. First, with regards to the general orientation of food security interventions it was shown that income diversification will be essential to increase access to food.

- The goal of Title II programs is to reduce poverty and food insecurity, and not simply to increase cereal crop production.
- The longer term potential for achieving this goal will require continued improvement in education and off-farm employment.
- Agriculture will remain a critical programming area, but there are objective limitations to the productivity improvements that can be made, and focusing on agriculture alone to improve food access will not be sufficient.

Second, with regards to agriculture itself, several elements appear binding on improving the performance of this sector. In particular, we noted:

- Access to oxen.
  - Oxen lease and sharing arrangements should be promoted to overcome shortages in this area.
- Access to capital.
  - Factors such as household wealth, and level of productive assets, exert significant positive effects on yields, indicating the importance of the capital constraints faced by farmers.
  - Plot level determinants of agricultural performance include soil quality and fertilizer use. Overcoming those constraints require capital.
  - The size of the family labor pool is also a key determinant of production. Increasing the application of labor to the land; or using labor-saving devices both require capital.
  - Smaller farms appear to be more productive than larger ones. This is encouraging, but those farms are likely to face economic constraints in the process of intensification.
  - Development of micro credit and credit institutions can help farmers overcome capital constraints, particularly for longer-term credit, as it is difficult for farmers to repay loans for large items within the usual one year term.

- Institutional support:
  - The presence of CBOs providing agricultural extension was shown to have positive results on farming performance.

- Technical assistance is much needed, and should proceed from a recognition of the location and crop-dependence of the technologies and land management approaches to promote. Top-down, "one-size-fits-all" approaches to technical assistance do not work well in the diverse circumstances of Ethiopia.
- More knowledge is needed on aspects such land conservation technologies, land tenure, fertilization technologies which were shown to have mixed effects on productivity. Those are important in theory, but the practical implementation of interventions in those areas need further research in Ethiopia.

Third, with regards to health and nutrition a series of interventions may be recommended, each targeting a particular aspect:

To improve the diet of children:

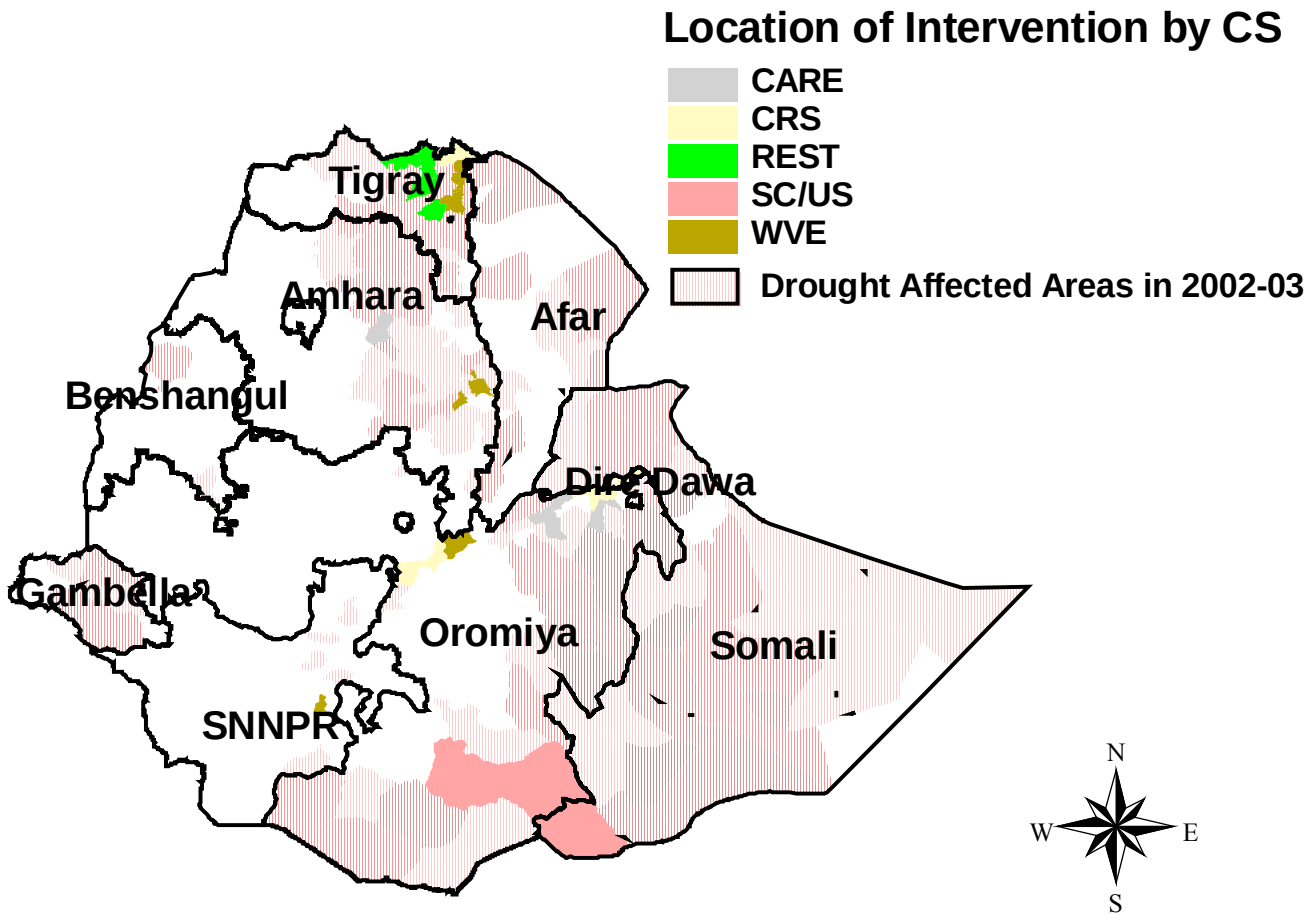
- Promote exclusive breastfeeding throughout the first six months of life;
- Promote the initiation of breastfeeding less than one hour after delivery
- Promote continued breastfeeding, particularly after 18 months
- Increase the frequency of complementary feeds among children 12-24 months; and
- Increase the variety of food groups offered to all children
- Increase the intake of Vitamin A rich and animal source foods for all children.

To improve child health:

- Increase access to immunization services
- Increase access to Vitamin A supplementation
- Strengthen counseling in the comprehensive treatment of child illness (particularly diarrhea) across age groups, and in child feeding practices following episodes of sickness
- Target health messages to influential household members
- Improve household access to adequate water and sanitation.

To improve resources for care and support:

- Expand the target group for behavior change messages to include other relatives
- Implement components that raise the status of women, to increase their decision making role (education, income earning opportunities, etc).
- Support achievements in use of pre-natal care
- Increase access to trained health provider at delivery
- Design approaches to reach women during the post-partum period and emphasize the importance of post natal visits
- Increase access to post-natal care services, including vitamin A supplementation



Map 1: Location of intervention by CSs, and drought affected areas in 2002-2003

PART I

INTRODUCTION, CONCEPTUAL APPROACH AND METHODOLOGY

Chapter One. Introduction

Ethiopia's population in 2003 was estimated at approximately 67 million people[1]. In 2001, UNDP estimated that 81.9% of that population lived under US$1 per day and placed Ethiopia 92nd out of 94 countries on the Human Poverty Index, 169th out of 175 countries on the Human Development Index. The numbers underlying those indices are sobering: Ethiopians'life expectancy is 45.7 years, HIV/AIDS affects 6.4% of adults, one of every six children dies before age 5, and 52% of children under-five are stunted.

Since 1996, the US government in collaboration with several international NGOs have supported a number of food security projects in Ethiopia using PL-480, Title II resources with the aim of improving this situation. A first five year program, worth approximately US$40 million/year, was implemented by eight NGOs[2] between 1996 and 2002. It was followed by a second five year cycle (2003-2007) worth approximately US$ 20.4 million/year and implemented by five NGOs (CARE, CRS, REST, SC/US and World Vision). Each of the currently funded projects is multisectoral, covering variously the areas of health, nutrition, water and sanitation, agriculture, and natural resources management. Together, the five NGOs provide services to 479,000 Ethiopians, disseminated in five of the eleven Regions of the country (see map next page).

Title II NGOs (named hereafter Cooperating Sponsors, or CSs) must conduct a baseline survey when beginning their new program. This serves to assess the conditions prevailing in target areas at the outset, before the start of interventions so the progress made by the end of the project with respect to its targeted outcomes can be reliably measured. If appropriately implemented, a baseline survey can also help adjust the program's implementation design to the reality on the ground. This report presents the results from the baseline survey conducted jointly by the five CSs in Ethiopia between May and August 2003 as a prelude to their new 2003-2007 program. A total of 4636 households living in 24 of the most food insecure woredas in Ethiopia were interviewed across the five CSs on issues ranging from the nutrition of children to agricultural production. Six of the eleven Regional States of Ethiopia are represented in the sample[3].

The report is organized into four Sections and fifteen Chapters. Section One explains the context of the study. It is divided into this Chapter, the Introduction; Chapter Two, where we review the conceptual model underlying food security programming; Chapter Three which provides a brief outline of each CS program; and Chapter Four, which presents the methodology used in the baseline survey. Section Two presents the general results emerging from the baseline with respect to communities (Chapter Five), households (Chapter Six) surveyed, as well as individual economic activities (Chapter Seven). Section Three then turns to Agriculture (Chapters Eight to Ten) whereas Section Four focuses on the health and nutrition of surveyed populations. Section Five summarizes the findings, offers general conclusions and proposes recommendations for program implementation.

[1] CIA's World Fact Book estimates 66,5M, whereas UNDP mentions 67.3M
[2] Africare, CARE, CRS, EOC/DICAC, FHI, REST, SC/US and World Vision.
[3] Tigray, Amhara, Oromia, Somali, SNNPR and DireDawa.

Chapter Two: The Food Security Conceptual Framework

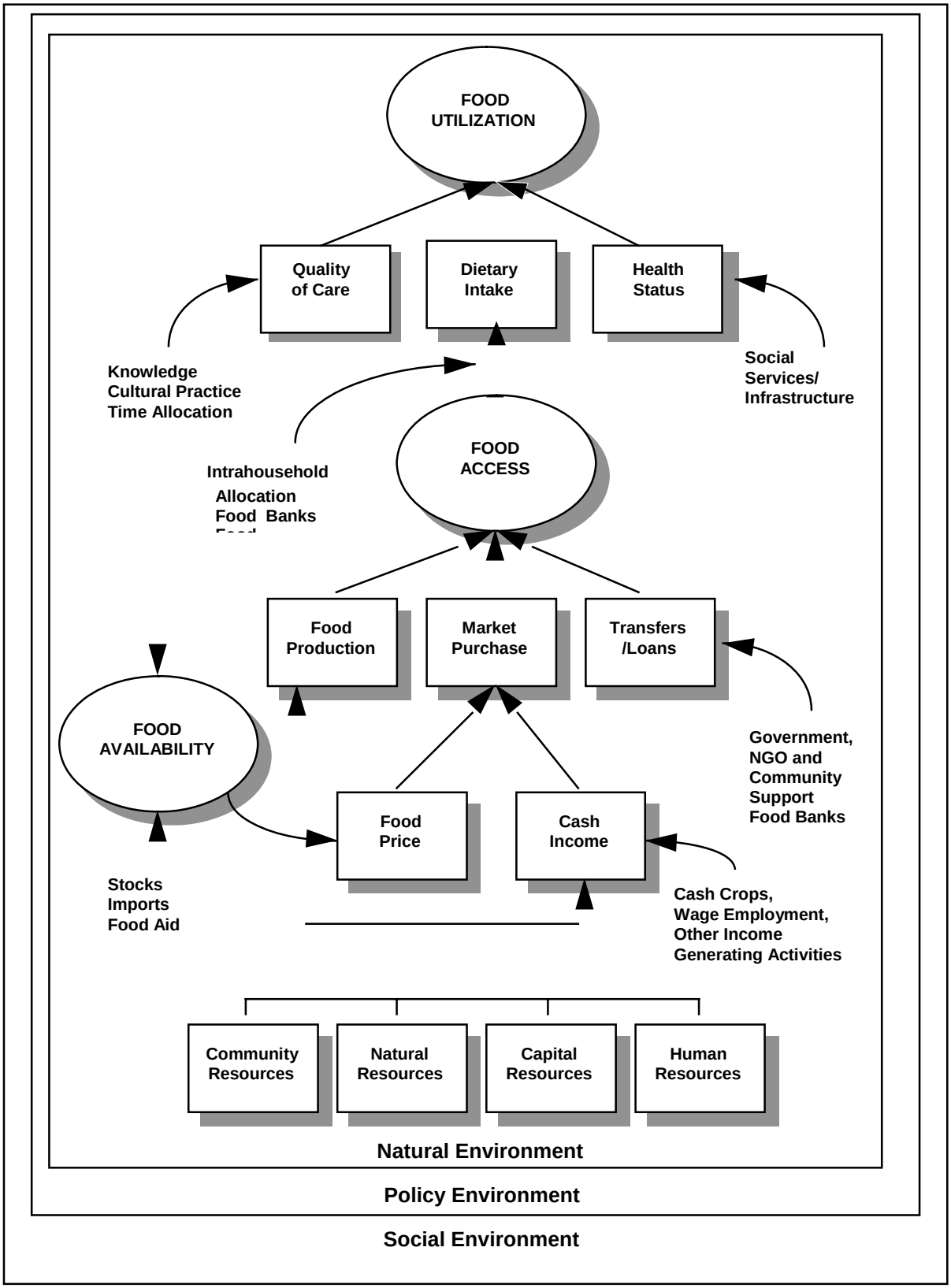
By congressional mandate, the main focus of the PL480, Title II program is Food Security. All NGOs that use Title II resources must therefore articulate their intervention in ways that enhance the food security of their beneficiaries. USAID, which administers the Title II program, defines food security as "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" (USAID, 1995). Achieving adequate food security is viewed as a critical step toward the more general development objectives of poverty alleviation and sustainable, broad-based economic growth. By definition, food security is a broad and complex concept, determined by a range of factors—agro-ecological, social and economic. For this reason, there is no single, direct measure of food security. Instead, the general concept of food security is divided into three distinct dimensions: food availability, food access and food utilization (see Figure 1). According to the definition:

- *Food availability* is achieved when sufficient quantities of food are consistently available to all individuals within a country. Such food can be supplied through domestic output, commercial imports, existing stocks or food assistance.
- *Food access* is ensured when households and all individuals within them have adequate resources to obtain appropriate foods for a nutritious diet. Access depends on the income (in cash or in kind) available to the household.
- *Food utilization* is the proper biological use of food, requiring a diet providing sufficient energy and essential nutrients, potable water, and adequate sanitation. Effective food utilization depends in large measure on knowledge within the household of food storage and processing techniques, and on basic principles of nutrition, child care and illness management.

As suggested by Figure 1, each dimension of food security (availability, access and utilization) may be affected by a range of factors.

- *Food availability*, when considered at the *national level*, is affected chiefly by the national economic context, itself a function both of international economic flows and of domestic macroeconomic and food policy decisions, including imports and food aid. *Food availability*, when considered at the *sub-national* level (regional or local), depends on the existence and conditions of internal food markets, themselves a function of (among other things) food supplies at the regional level, road and market infrastructures, and population demand.
- *Food access* is influenced by household production—which calls into question issues related to agricultural technology, land distribution, education, access to capital markets and the availability of inputs—and by household income, which depends on the general microeconomy—labor markets, supply and demand, product markets.
- *Food utilization* is premised on appropriate food intake, but also on the physical health of individuals, on the knowledge of caretakers, on access to safe water, on cultural beliefs with respect to food, on the prevention of epidemics, on reproductive health and family planning.

Figure 2.1. Food Security Conceptual Framework



In short, food security is an outcome that may be influenced by a wide array of development interventions. In a situation of adequate availability. most immediate impacts on food security will be achieved by increasing agricultural productivity, raising household incomes, and improving household nutrition, especially for children and mothers. However, the natural and socio-economic context in which food security interventions are undertaken often predetermines their long term impact and durability. Thus, other interventions that affect those predetermining conditions may be considered to influence food security as well. Table 1 provides examples of the main factors that relate to the various dimensions of food security, and the types of interventions that may be undertaken to affect those dimensions, either at the immediate (proximal) or underlying (distal) level[4].

Table 2.1: Factors and interventions associated with food security

Factors related to food availability at the *national* level	**Activities affecting aggregate demand and supply**
- International prices (food imports and export of tradable goods)	- Macroeconomic policies (liberalization, exchange rates, etc)
- National food supplies	- Domestic economic policies (sectoral investments), food policies (imports, food aid)
Factors related to food availability at *sub-national* level	**Activities affecting internal demand and supply**
- Transport infrastructure	- Road construction and maintenance
- Markets	- Communications, prices, commercial credit, food storage
- Population size and demand	- Family planning
Factors related to food access	**Activities affecting household level production and incomes**
- Agricultural productivity	- Research and extension, irrigation, human capital formation…
- Access to factors of production	- Land, credit, input supplies, labor markets…
- Natural Resources protection	- Reforestation, watershed protection, sustainable agricultural practices
- Post harvest handling	- Storage, food transformation technologies
- Micro-enterprise development	- Micro-credit, farm sales, Income Generating Activities (IGA)
Factors related to food utilization	**Activities affecting individual capacity to utilize food**
- Maternal and child health and nutrition	- Micro nutrients supplementation or fortification, nutrition education, behavior change, child survival, prenatal care…
- Provision of health services	- HIV/AIDS, family planning, immunization campaigns, deworming…
- Water and sanitation	- Water and sanitation education, wells/latrine construction…

[4] Note that interventions may simultaneously affect more than one dimension: for instance, interventions that improve agricultural productivity affect both households' access to food, and the aggregate availability of food. Likewise, family planning, which results in less mouths to feed, affects both food utilization at the individual level, and food availability at the aggregate demand level. Hence the dimensions of availability, access and utilization are not mutually exclusive—the subdivisions are mainly useful for organizational purposes, and should not be construed too rigidly.

Chapter Three: The Title II Program in Ethiopia, 2002-2006

This chapter provides an overview of the PL480 Title II food security projects currently implemented in Ethiopia. Details on the strategic objectives, intervention design, geographic coverage, and resources available are offered for each of the five currently approved Cooperating Sponsors' Development Activity Program (DAPs).

This is the second cycle of Title II DAPs in Ethiopia. The first cycle (1996-2002) emphasized mainly Agriculture and Natural Resources Management. Maternal and Child Health and Nutrition (MCHN) activities were also implemented, yet AG/NRM absorbed the bulk of the resources channeled through the Title II program. The current, second cycle saw a major transition in the design and content of the Title II programs. MCHN activities now occupy the center stage, with agricultural programming coming second in importance. A second important change is in the lineup of PVOs operating the Title II program which went from eight to five as CARE, CRS, REST, SC/US and World Vision continued on a second cycle and not Africare, EOC and FHI,.

To apply for PL480 Title II funding, each Cooperating Sponsor must define a set of program specific strategic objectives, and a corresponding intermediate result framework for the proposed food security program. The strategic objectives should represent the general outcomes to be achieved over the length of the program activity, and guide the design of project related activities, as well as the monitoring and evaluation plan outlined by the Cooperating Sponsor. For the period of 2003-2007, the five Ethiopia Title II CSs share largely similar strategic objectives. As mentioned already, the CS programs currently intervene in health and nutrition, food access, agricultural production, and natural resources conservation. General themes under each technical sector can also be identified that are largely common between CSs. For example, program interventions under the maternal and child health sector generally target vulnerable groups (mostly lactating and/or pregnant women and/or children) for behavior change/communication activities, and improved outreach and community based health services. Under the agricultural sector, the scope of interventions relate generally to agricultural extension activities, promotion of market opportunities for farmers, and increased access to income generation opportunities and food for work activities. Direct food distribution is used in many of the above CS program interventions; while "monetization" (sale on regular markets) of donated food helps to support the cash needs of the interventions.

Certain key strategies guide the design of each Cooperating Sponsor's Title II program. The key strategies are derived largely from lessons learned through past experience in implementation of PL480 Title II programs. Across Cooperating Sponsors, several commonalities in programming strategies are reflected. These include:

- Enhanced geographic coordination and integration of program activities
- Community based interventions, with a focus on sustainability of program activities
- Increased attention to gender in the design of activities
- Emphasis on local capacity building and civil society
- Strengthening of M&E systems, to document impact and inform on-going program implementation

The geographic coverage provided by the five CSs is extensive (see map). CARE works in the Amhara and Oromiya Regional States, while CRS focuses its activities in Tigray, Oromiya and DireDawa. REST works essentially in Central and Eastern Tigray, while Save the Children is active in neighboring pastoralist communities straddling across the Oromiya and Somali Regional States in the South. World Vision finally has programs in four of the six regions, namely Tigray, Amhara, Oromiya, and SNPP. Altogether, the CSs are expected to reach a total of almost half one million beneficiaries during the year 2004 alone; this number will increase as the programs get deployed.

Table 3.1. Title II programs in Ethiopia: beneficiary levels and resources streams

	CARE	CRS	REST	SC/US	WV	Total
Beneficiaries (FY2003)	42,275	26,615	99,324	265,000	45,873	479,087
Amount of food (LOA MT)	23,055	78,301	48,430	14,920	19,520	184,226
% Monetized (LOA)	14.7%	3%	3,950,968	13.61%	21%	
T-II cash resources (LOA)	3,575,361	3,419,148	4,288,788	2,853,851	6,281,990	20,419,138
DA cash resources (LOA)	3,166,440	6,603,374	4,079,924	2,797,669	0	16,647,407

As mentioned earlier, the layout of the programs contain several similarities across CS. Table 3.2. below summarizes the main features of each program. All CSs maintain activities in the key areas of health and nutrition, and agricultural production and NRM. Only CRS has invested itself in Social Safety Nets.

Table 3.2. Summary features of the Title II programs in Ethiopia

	CARE	CRS	REST	SC/US	WV
- Child nutrition	X	X	X	X	X
- Maternal health and nutrition	X	X	X	X	X
- Reproductive health	X		X	X	
- Family planning	X		X	X	
- TB/HIV-AIDS	X	X	X		X
- Water and sanitation	X	X	X	X	X
- Institutional capacity building	X	X	X	X	X
- Ag extension in production techniques	X	X	X	X	X
- NRM through FFW and behavior change	X	X	X	X	X
- Market development		X			X
- Income generation activities	X	X	X	X	X
- Local emergency response capacity	X	X	X	X	X
- Production of animal source foods			X	X	X
- Social Safety Nets		X			
- Emergency response	X	X	X	X	
-Community food security early warning	X			X	

Beneath the surface, however, there are important differences in how the DAPs are organized, which contrasts those programs in meaningful ways. For instance, some of the CSs use a Positive Deviance model in their MCHN activities, whereas others base their intervention on Growth

Monitoring and Promotion; or else, progams like CRS work from a watershed development paradigm whereas others use the more usual population catchment as a means of targeting. Those differences are important, and may lead to different levels of performance across CSs. Although it is not the intent of this survey to compare performance across CSs, it will be instructive to look retrospectively at the various intervention approaches when the follow up survey data is available, and try to understand why they may have a differential impact on the objectives of the respective programs. This opportunity to understand better what works, what does not work, and why, is an important motivation for conducting the baseline and follow up surveys ;jointly, using standardized indicators and benchmarks.

Additional details are provided on the contents and modes of operation of the individual CS programs in the Development Activity Proposals (DAPs) which were submitted by CSs to USAID/DCHA/FFP. Those documents may be requested from the CSs themselves.

Chapter Four. Baseline Survey Methodology

The study is based on survey data collected by the CSs in their areas of intervention. Data were collected between May 30th and August 7th, 2003. Intense preparation for the survey took place during the previous months with FANTA support, and involved discussions about the type of evaluation design; design of the sampling methodology; design of field instruments; survey logistics; and data entry.

Types of Evaluation Designs

Three main types of designs may be used in pre/post evaluation studies: Adequacy (Simple before/after comparisons); Plausibility (Before/after comparisons with controls) and Probability (Causal analysis of before/after differences) (Habicht and Victora, 1999). Preliminary consultations between the CSs and FANTA led to the selection of a plausibility design, with historical and internal controls used at the Final Evaluation stage. As mentioned in the Sampling section below, the longitudinal (historical) element of control operates at the community level (i.e. the same communities will be measured in the baseline and final surveys); different cross sections of households will be drawn at each stage in those communities through random sampling. Internal controls will be provided at the Final Evaluation stage by comparing households that could have participated in the intervention, but for some reason could not or chose not to.

The choice of this type of design requires that a conceptual framework be devised to identify appropriate confounding factors and/or factors that may co-determine the outcomes. Those conceptual frameworks are presented in the Sections where we discuss sectoral findings, each chapter beginning with a discussion of the conceptual framework used to model outcomes in that particular area of intervention.

Sampling

A classic two-stage cluster sampling design was used to collect the data used in this survey. Primary units (clusters) were villages, selected using PPS (Probability Proportional to Size). Secondary units were households.

The first step in determining the sample size consists in selecting a variable on which to base the sample size calculations. One problem when working in the context of multisectoral programs is that they target several outcomes at once (nutrition, agriculture, etc). Since sample size calculations can be based on one indicator only, a choice must be made as to which outcome will be used in doing the calculations. Three options present themselves: the first option involves listing all the outcomes, and selecting the indicator that is most demanding from the sampling point of view. This allows to satisfy the demands of all other indicators, but may lead to the selection of a unacceptably high sample size (and survey cost). The second option involves selecting the indicator that is considered most important from the project's point of view. Doing the calculations on that basis ensures that the sample size will be adequate at least for the key indicator. The third option is to compute both options above, and chose between those two the largest number that is feasible from a logistical and cost standpoint. This option ensures that the sample size will be adequate for the key indicators and that we will have the best possible

estimations for the more demanding indicators, taking available resources into account (Magnani, 2002).

Given budgetary limitations, a variant of the third option was used in this baseline survey. The indicator selected to base calculations is stunting, or the proportion of children 6-59 months of age that fall below -2 standard deviations on the Height-for-Age z-score distribution. This choice is appropriate as a) stunting rates among young children in the population is arguably the highest-level outcome that may be affected by a food security project; and b) this indicator puts relatively high demands on statistical proof, resulting in a sample size that is much higher than if we were to use, say, agricultural yields. In other words, the choice of this indicator ensures that the demands made by most other outcomes will be satisfied by the final sample, while maintaining costs at an acceptable level, since sampling for stunting remains within reasonable bounds.

The second step in deciding the sample size is to determine the magnitude of the expected effect. An agreement was reached with the CSs that they should expect a reduction of at least 7 percentage points in stunting level among children 6-59 months (from 52% to 45%, the 52% baseline value being provided by the DHS 2000 survey) over the five years of implementation. These parameters were used to set the size of the sample. Additional parameters that went into the calculation included the probability of detecting a change that is true (alpha, set at .90) and the power to detect a change if it has really taken place (beta, set at .80). Three further parameters were introduced to the calculations: first, the design effect to compensate for the use of a cluster sampling method was set at 2.0; second, it was assumed that 1.2 households had to be visited in order to find one child of the right age group (6-59 months) (we call this the demographic correction); and third, a "security factor" of 10%, added to account for attrition and non-response. Using the formula for changes in proportions[5], we concluded that a sample of 607 children of 6-59 months of age was required per CS area. We then applied the demographic correction and the security factor, yielding a total of 917 households per CS that had to be visited in order to find the 607 children per CS. The cluster design factorial was set at 30X31 (thirty clusters, or localities, with 31 households in each), yielding 930 households, or a total of 4650 across the four CSs. Field level fluctuations in the end yielded a total number of 4636 households visited—fourteen less than expected. However the desired number of children was far from being obtained in this sample of households. Rather than the expected 607 children per CS, we found less in all CSs except SC/US The problem is due to an erroneous assumption in the demographic correction needed—rather than 1.2, we should have used 1.6[6]. Changes were thus required in the initial sampling parameters to adjust for the shortfall: the design effect was recalculated using actual data values, as a result of which the true design effect was found to be 1.5 (rather than 2). That correction was still insufficient, however; so we took the alpha level

[5] $n = D\,[(Z_a + Z_b)^2 * (P_1\,(1 - P_1) + P_2\,(1 - P_2))\,/(P_2 - P_1)^2]$ where n = mimimum size of the sample for each survey or comparison group; D = design effect for cluster designs (we assume an implicit value of D = 2); P_1 = the level of the indicator when measured as a proportion at the time of baseline, or for the control zone; P_2 = the expected level of the indicator either at a future date, so that the quantity (P_2 - P_1) is the size of change that is targeted; Z_a = the Z-score corresponding to the degree of confidence desired in order to conclude that a change of the size (P_2 - P_1) is not due to chance (a – statistical significance level); and Z_b = the Z-score corresponding to the degree of confidence desired in order to detect with certainty a change of the size (P_2 - P_1), if such a change has effectively taken place (b –statistical power).

[6] The figure of 1.2 is an international standard (see Magnani, 2000). It appears that the demographic distribution is different in Ethiopia from those standards.

down from .90 to .80. The resulting sample size for detecting a 7% reduction in stunting rate is 429. All CSs met this revised criterion[7].

Indicators and Questionnaire Design

One particular feature of this survey is that it is jointly undertaken by five different development organizations. The underlying implication to the use of a joint instrument is that all five of them have the same data needs. This is not entirely true, however, since not all of them intervene in the same sectors of development or in the same way in each area. Between-program differences were accommodated by designing the questionnaire in a modular form, so that each CS could select and implement the set of modules that would best suit its particular needs. The complete set included ten modules, two of which were common to all surveys (the community questionnaire; and the household socio-economic and demographic questionnaire). The seven additional modules were to be appended at will by the CSs to those two common ones. The full set included the following modules:

Module 1: Community survey
Module 2: Household socio economy and demography
Module 3: Household members' education
Module 4: Child anthropometry (6-59 months)
Module 5: Mother's pre/postnatal care
Module 6: Child feeding (6-59 months);
Module 7: Child health (6-59 months)
Module 8: Infant health and feeding (0-5.99 months)
Module 9: Agriculture and natural resources.
Module 10: HIV/AIDS (female and male)

The instruments were initially prepared in English, then translated into Amharic, Tigrina, Oromifa and Somali, field tested and updated. The final set of questionnaires and manuals used are included in a CD available upon demand from the authors of the report.

Key outcomes and Confounders

The joint nature of this baseline survey required that a common set of outcome indicators be defined. As already mentioned, this posed problems as the CS programs are not identical. Still, there is enough overlap to allow for the identification and selection of a common set of outcomes. For instance, all CSs have Maternal and Child Health and Nutrition (MCHN) programs, or Agriculture and Natural Resources Management (AG/NRM) programs under which they pursue goals that are generally similar and compatible. In some cases, however, interventions are so distinct as to make harmonization impossible (e.g. SC/US's work with pastoralists). The modular design of the field instruments allowed to incorporate those differences.

It was also crucial to arrive at a common theoretical understanding of what is likely to influence the outcomes pursued by each program, so we have the data needed to control for whether the

[7] CARE was found to have 567 measured children; CRS, 517; REST, 541; SC/US, 742; WV, 438.

before and after effects are caused by the project or by external factors beyond its influence. This required that CSs agree on a conceptual framework representing the determinants of the effects. A series of meetings were held to define such conceptual frameworks and to identify the indicators needed to reflect the main effects as well as the appropriate correlates and confounders. Those conceptual frameworks are presented at the beginning of each sectoral chapter in the Results Section of this report. The resulting set of indicators defined the data to be collected.

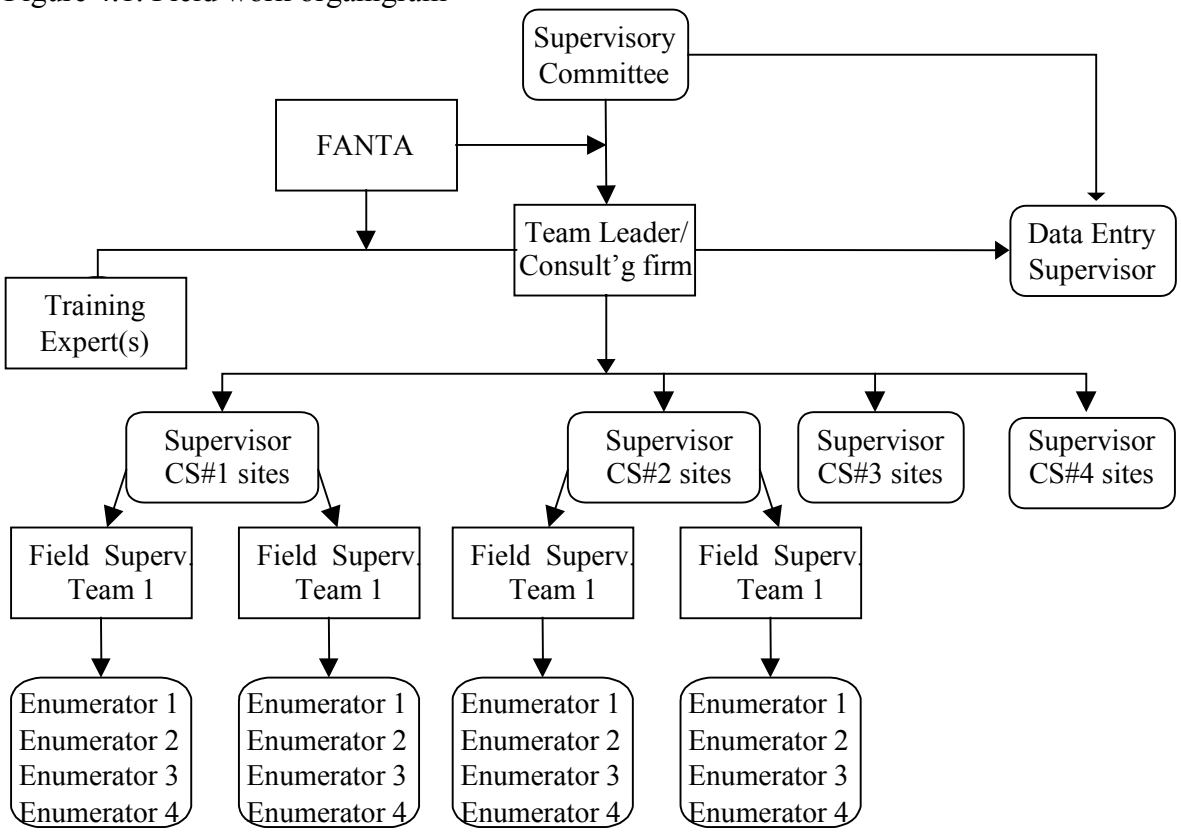
Structure of Field Operations

Staffing

To minimize costs and maximize the potential for institutional capacity building, the baseline survey used a combination of external experts and project staff. A specialized firm (AGRIDEV) was hired to do the training, provide field coordination, enter the data and write the interim reports. Fourteen experienced team supervisors were hired to oversee the fieldwork. CSs' M&E officers were also used to supervise the various teams, ensure coordination between field sites and organize the logistics. Seventy program staff were trained in survey techniques and used as enumerators. Each of them then trained a "shadow enumerator" who would accompany them in each visit to help record the data and do the anthropometric measurements. General supervision was provided by AGRIDEV, itself under the control of a Supervisory Committee formed of representatives of each CS, plus USAID/Ethiopia. Technical assistance throughout the process was provided by FANTA. CARE and REST staff played the coordinating role between the SC and AGRIDEV during the fieldwork phase. The general structure of operation is represented in Figure 4.1.

Particular attention was paid to the training of supervisors and enumerators. The full training lasted four weeks, with one full week dedicated to anthropometry alone. AGRIDEV's sectoral specialists ensured the training on all modules except anthropometry, for which an international expert was hired. The seventy enumerators and fourteen supervisors were trained in all aspects of the survey. Enumerators and supervisors were trained in the art of taking standing height and recumbent length measurements and weight of the children as well as mid upper arm circumference (MUAC). There were several practice sessions in orphanages and day care centers during which standardization tests were performed on standing heights, weights, and MUAC. Field trials were conducted on the last week of training. These field trials gave the team the opportunity to simulate the survey under field conditions and also provided data used to fine tune instruments and procedures.

Figure 4.1. Field work organigram



Note: Square boxes represent external expert consultants. Rounded boxes represent CS staff

Logistics

CS used varying numbers of enumerators, so the pace of implementation of the survey varied slightly from one CS to the other. Each enumerator team was theoretically expected to complete two interviews per day on average. The supervisor checked all filled questionnaires on a daily basis. The supervisors were also in charge of completing the community module.

Each CS facilitated the implementation of all activities in their respective zone so that everything would be in place (vehicles, lodging, etc) for the enumerators and supervisors to execute their activities. Sectoral experts from AGRIDEV (nutritionist, statistician, economist, agronomist) spent time in each CS area working with the coordinators and supervisors to ensure overall coordination and data quality.

Field Work

Upon the day of arrival in the locality, the team supervisor selected a series of departure points from which each sub-team would proceed. Households within a cluster were chosen following the "spin the bottle" methodology, done by randomly choosing a direction from the assigned starting point; conduct an interview in the nearest household; then continue choosing the next

nearest household in that direction and interview every household until the 31 households were completed. While the enumerators were doing the household interviews, the supervisor met with community leaders or other key informants to fill the Community Questionnaire. At the end of the day, the supervisor reviewed all the questionnaires completed during that day by members of his/her team. Once every few days, on a schedule planned in advance, the set of completed surveys were sent to headquarters, where they were made available to AGRIDEV for data entry. Enumerators left for the field on Tuesday May 30th and ended field work on August 7th.

Data Entry

Data entry was completed August 15th, although data clean up continued until November, as the team doing the analysis uncovered problems hidden in the datasets. A portion (10%) of the data was entered using double entry protocol. Random visual comparisons between original forms and computer database were performed after the data was entered on the data that had not been double-entered. The data coding routines and entry programs are available on a CD ROM that may be requested from the authors of this report.

Data Analysis

Data was analyzed using SPSS version 12.0. The initial analysis was performed on the entire sample of 4636 households at FANTA in Washington DC. That report was sent to USAID and the CSs at the end of February 2004 for comments. Two of the authors travelled to Addis in March 2004 to discuss the findings and collect Ethiopia partners' comments to the first draft. Those comments were incorporated, after which the CSs were handed the Tables corresponding to their respective sample, so they could replicate the analysis for their own specific areas. FANTA staff took great care to fully document the programming routines, so that the analyses and tabulations could be replicated consistently at the Final Evaluation stage, which should replicate the baseline survey model. The full set of programming routines (syntax files, output files, tabulation results, etc) is available on CD ROM included with the hard copy of this report. It may also be made available upon demand from the authors via the FANTA project website (fantaproject.org). The CSs also have a hard copy of the report and the CD ROM at their Ethiopia headquarters.

The analysis proceeds systematically by first describing the data using simple frequency distributions of main outcomes and covariates. Further exploration of the data is next done by doing a series of bivariate tabulations. The bivariate relations selected for tabulation were suggested by the conceptual framework devised in the early stage of designing the baseline (see section above). These bivariate relationships are tested using simple statistical procedures such as Chi square, correlation coefficients, means tests and ANOVA. Corresponding probability coefficients are reported where appropriate. This first analysis of the data allowed the formulation of a number of hypotheses which were then tested again using multivariate analysis techniques (OLS, Tobit and Logit). This last step allowed to identify the true effect of identified covariates or confounders, holding everything else constant. The final recommendations of this report are largely based on the findings generated by the multivariate procedures.

PART II

SURVEY RESULTS:
COMMUNITY AND HOUSEHOLD CHARACTERISTICS

Chapter Five: Community Characteristics

The first interview was done on March 30th, 2003 and the last one took place on August 7th, 2003. A total of 4636 households were visited. The survey period corresponds to the end of the dry season, when households' reserves are at their lowest and harvests from crop sown in earlier months have not yet begun to provide new commodities. The survey was therefore executed during the lean season. Furthermore, that year in Ethiopia was particularly hard on producers, with droughts affecting large portions in the East, Rift valley and the South. As a result agricultural performance suffered markedly and food security indicators collected in the study appear to be alarmingly low. This will undoubtedly complicate the assessment of progress to be performed at the Final Evaluation stage in 2007, when that data will be compared to this Baseline.

General survey findings are described in this section of the report (Part II). Chapter Five includes first, a description of communities, while Chapter Six provides a description of the household characteristics. The sectoral findings related to Agriculture, water and sanitation and health/nutrition are presented in Parts III and IV of the Report.

Localities Visited

The survey began on May 30th and ended on August 5th, 2003. A total of 151 villages were visited, 30 in each CS area except for CARE who has 31 villages. Those villages were found in 139 Peasant Associations (PAs) over 24 woredas of four regions (Amhara, Oromia, Tigray, SNNPR and DireDawa). The population by village averaged 1639 persons, although we found much variation in this regard, with the smallest and largest villages having 65 and 7500 inhabitants respectively. Upon arrival in each village, the supervisor held a meeting with community leaders to collect various pieces of information describing local characteristics. The great majority of villages visited (142, or 94%) were in rural areas. The villages are dispersed in 58.9% of cases, and densely settled in 41.1% of cases (Table 5.1.). This pattern is similar across all CS areas, with a notably large proportion of settlements in SC/US being dispersed rather than dense.

Table 5.1. General characteristics and location of settlements surveyed

Type of land use		CARE	CRS	REST	SC/US	WVI	Total
Village Settlement:	Urban	9.7	8.2	6.7	3.3	10.0	6.0
	Rural	90.3	91.8	93.3	96.7	90.0	94.0
Settlement type	Dense	45.2	43.3	46.7	23.3	10.0	33.8
	Dispersed	54.6	33.3	46.7	76.7	83.3	58.9
	Other	--	23.3	6.7	--	6.7	7.3

Topography varies from one village to the other. The most common setting is hilly terrain (39.1% of villages). Roughly a third of them (31.5%) are in mountainous areas, and the remainder (28.8%) are in flat terrain. The settlements straddle across the various agro-ecological zones found in the country, with about half (48.3%) found in *Woyena Dega*, a third (35.1%) in *Kolla* and the remainder (16.6%) in *Dega* (Table 5.2). This is not surprising for anyone who knows Ethiopia; but it suggests that a wide variety of situations are represented in our sample,

indicating a need for factoring in the physical characteristics of the villages when interpretating results.

Table 5.2. Physical location of villages (% in each category)

Type of land use		CARE	CRS	REST	SC/US	WVI	Total
Topography	Flat	34.5	23.3	23.3	93.3	10.0	28.8
	Hilly	41.4	23.3	60.0	6.7	53.3	39.7
	Mountain	24.1	53.3	16.7	--	36.7	31.5
AEZ	Kolla	16.1	33.3	50.0	18.5	10.0	35.1
	WoynaDega	58.1	63.3	43.3	81.4	53.3	48.3
	Dega	25.8	3.3	6.7	--	36.7	16.6

Kolla: <1,500m; WoynaDega: 1,500-2,200m; Dega >2,200m

This agroecological complexity is further compounded by the fact that CSs do not necessarily focus their interventions in geographically homogenous areas. Alghough two PVOs operate in areas that are largely similar throughout (REST in Central Tigray, SC/US in the Liben/Filtu plateau); the geographic focus of the other three CSs is diversified (CARE has project sites in Amhara Oromiya; CRS works in Tigray, Oromiya and DireDawa; and World Vision works in Tigray, Amhara, Oromiya, and SNPPR). To help control for this, a new variable (socio-economic regions, or SERs) was created that classified CSs' areas of action in 7 SERs (Table 5.3.):

Table 5.3. Location of intervention areas by CS

CS	Region	Socio Economic Region	Zone	Woreda
CARE	Oromiya	East & West Hararghe	West Hareghe	Chiro
				Doba
			East Hareghe	Bedeno
				Kurfachell
	Amhara	South Gondar & Wello	South Gondar	Laygaint
CRS	Tigray	Tigray	Tigray	Gulomekeda
				Irob
	Oromiya	East Shoa	East Shoa	Dugda Bora
				Adama
		East & West Hararghe	East Hareghe	Meta
				Goro Guttu
				Kersa
	DireDawa	DireDawa	DireDawa	Dire Dawa
REST	Tigray	Tigray	Central Tigray	Degua Tembien
				Werie Leke
				Mereb Leke
				Ahferom
SC/US	Oromiya	Liben/Filtu	Liben	Liben
	Somali		Filtu	Filtu
WVE	Amhara	South Gondar & Wello	South Wello	Ajibar

Table 5.3. Location of intervention areas by CS

CS	Region	Socio Economic Region	Zone	Woreda
	Oromiya	East Shoa	East Shoa	Boset
	SNNP	GamoGofa	GamoGofa	Chencha
	Tigray	Tigray	East Tigray	Wukro
				Tseada Emba

It is important to understand what this "Socio Economic Region" (SER) variable refers to: since sampling was not broken down by SER but by program area, SER is not representative of the population living in those areas (e.g., some SER areas have very low population compared to others; see Table 5.4). The variable is useful, however, when creating other indices (e.g. Socio Economic Status Index of the households) as it allows to reduce the variation found between regions when computing factor scores. It was also the prime stratification device used in the econometric analysis presented in Chapter Ten.

Table 5.4. Socio economic regions covered by the sample

SER	N of woredas in this SER	N of households sampled in SER
East & West Hararghe	7	891
South Gondar & Wello	2	210
Tigray	8	930
East Shoa	3	739
DireDawa	1	62
Liben/Filtu	2	1633
GamoGofa	1	184

Land Use in Sampled Areas

Community leaders were asked to report how the land is used in their area. Their estimates suggest that overall, half of the land is cultivated. The second most important category is pastures, followed by forest/plantations then by waste lands. It is notable that the proportion of fallow land is everywhere quite small, suggesting a generally high pressure on the land. Some interesting differences are also noted between CSs: the largest proportion of land goes to cultivation in all CS villages except SC/US's Liben/Filtu clusters, where the major use is for pastures—not surprising given the pastoralist vocation of that area. Also, unused lands (forests and waste land particularly) are important in the CRS area (50% if including water bodies and swamps).

Table 5.5. Mean proportion of land under different Uses by CS (%)						
Type of land use	**CARE**	**CRS**	**REST**	**SC/US**	**WVI**	**Total**
Land under cultivation	61.2	44.6	64.6	23.9	55.1	50.0
Fallow land	.65	4.23	7.5[8]	6.5	1.5	4.0
Forest *	13.4	21.7	11.3	13.5	14.5	14.9
Pastures	12.3	5.2	9.9	43.0	18.7	17.8
Swamps	1.2	3.3	.50	1.7	.7	1.5
Water bodies	1.3	1.3	0	3.8	.2	1.3
Waste land	12.9	19.4	6.7	8.4	12.1	11.9

**Forest include bush, woodlots, energy plantations and multiple-use forested areas*

Community Access to Services

Basic data on the localities' access to a set of services was collected for each cluster. We describe those services in two subsections below: first, access to commercial services; second, access to health services[9].

Community Access to Commercial Services

Data on the presence, distance and means of access to the closest weekly market, agricultural input supply facility, veterinary health post and the closest general store was obtained. The distance to the nearest point where public transportation is available was also recorded. This information is important in a number of regards, most especially in relation to economic production: proximity to markets and sources of supply invites producers to interact with market operators in a more consistent manner. Under this presumption, we may hypothesize for instance that the closer the distance to market outlets, the higher the number of market exchanges taking place. Also, it may be hypothesized that shorter distances to markets increase producers' access to market information, improving their relative position as well. In addition, the proximity of commercial services offers producers a means of acquiring key agricultural production inputs such as fertilizer, seeds, and others. Finally, the availability of roads and the use of public transport enable producers to bring their commodities to markets, and to bring back necessary production supplies. These various relations will be examined in more details in the Agricultural Section. In the section below, we simply describe the villagers' access to basic commercial services, assuming they start from the locality center.

Weekly markets are found at a mean distance of 14.8 kilometers; agricultural input supply facility at a mean distance of 27.3 kilometers; and stores (small rural kiosks) at a mean distance of 12 kilometers. Animal veterinary posts are at an average distance of 14.1 Kms, and grain milling facilities are at 11.1 Kms. Regular transportation services are generally far away, at an average distance of 29.3kms. There is some variation in those figures by region: for some

[8] The higher proportion of fallow land in Tigray may be due to the drought: some farmers may have decided not to plant given the lack of rains.

[9] Data was also collected on schools, but the report does not elaborate on this as CSs do not work with schools in Ethiopia. In brief: all localities have access to a primary school but the average distance of 4.8kms is not negligible, considering it has to be covered twice daily by relatively small children. Particularly, in the SC/US area, children must walk close to 9kms on average to go to school. This may affect the levels of schooling among that population.

localities, going to a market site may involve traveling as much as 29 Kms, as in the SC/US area; regular transportation services are also very distant in that area, at more than 80 Kms. distance.

Those figures suggest that most households in our sample are located quite far from any type of commercial services, particularly those providing specialized transportation and agricultural inputs. This certainly affects farmers' propensity to interact with the market. We will return to this issue in Chapters Nine and Ten, when we examine the factors that determine farm production. Other commercial services such as grinding mills are less distant, but seem still too far (except in the REST area) for women to contemplate walking daily to those sites to get their grain processed. This suggests that grain milling is still a chore done mostly by women in a largely traditional way.

Table 5.6. Mean distance in kms from the locality to various commercial services

Type of Service	CARE (n=31)	CRS (n=30)	REST (n=30)	SC/US (n=30)	WV (n=29)	Total
Weekly market	10.16	14.38	11.43	28.97	8.78	14.76
Store, kiosk	9.77	10.24	6.37	25.90	7.16	11.92
Agricultural input supply facility	10.82	15.93	12.19	71.60	26.72	27.32
Animal vet post	11.76	10.02	11.60	26.74	11.87	14.13
Grinding mill	6.16	5.69	2.90	35.03	6.02	11.13
Regular transportation service	14.68	14.82	24.27	80.27	11.65	29.33

Community Access to Health Services

Access to health services varies considerably, depending on the type of service considered. The decentralization of health services through training of local birth attendants and health agents, and the use of public health stations or village health posts clearly makes a big difference in terms of access. As shown in Table 5.5., decentralized health staff such as trained birth attendants are always available at distance of less than four kilometers from the localities. Basic health facilities are also within relatively close distance (average of 5kms for village health posts, 11 kms for public health stations)[10]. Comparatively, however, specialized health services are much farther away, hospitals being at an average distance of 50kms, health centers at 40kms and private doctors at 52kms. Drugstores and pharmacies are also at an average distance of 17kms. Note also that one CS area (SC/US's Liben/Filtu plateau) consistantly register higher distances on all types of health services investigated here, which raises the overall means for all services.

Table 5.7. Mean distance in km from community center to various health services

Service type	CARE	CRS	REST	SC/US	WV	All
Hospital	51	55	44	44	58	50
Health center	20	20	14	14	22	40
Private health clinic	10	19	9	50	22	20

[10] Means of transportation to any health service site is generally by foot (75% of the time). Other means (motor vehicle, 16%; pack animal, 6%) are used only when the distance to cover is high, such as for hospitals, private doctors, dispensaries or pharmacies. This explains why the distance to a site and the time spent reaching it are not necessarily in proportion.

Service type	CARE	CRS	REST	SC/US	WV	All
Public health station (PA)	6	15	6	15	9	11
Healthpost (village level)	n/a[11]	8	1	n/a	7	5
Private doctor	39	23	45	86	56	52
Nurse, trained medical attendant	17	17	11	37	13	20
Health agent	4	16	2	30	4	14
TBA	4	3	2	4	4	3
Pharmacy, Drug Store	14	17	11	33	11	17

Community informants were asked if they knew whether a set of health services and supplies were available at the various points where health providers are present. Note that we did not ask whether or not the services and supplies were currently available. We only asked respondents if they *thought* the health service offered that particular service or item. The data below therefore represents perceptions rather than actual facts. This is still important, as perceptions drive behavior: people will not go somewhere if they think they will not find there what they are looking for. If that information is incorrect, however, they may deprive themselves of services that are in principle available to them. Such a situation would have clear programmatic implications.

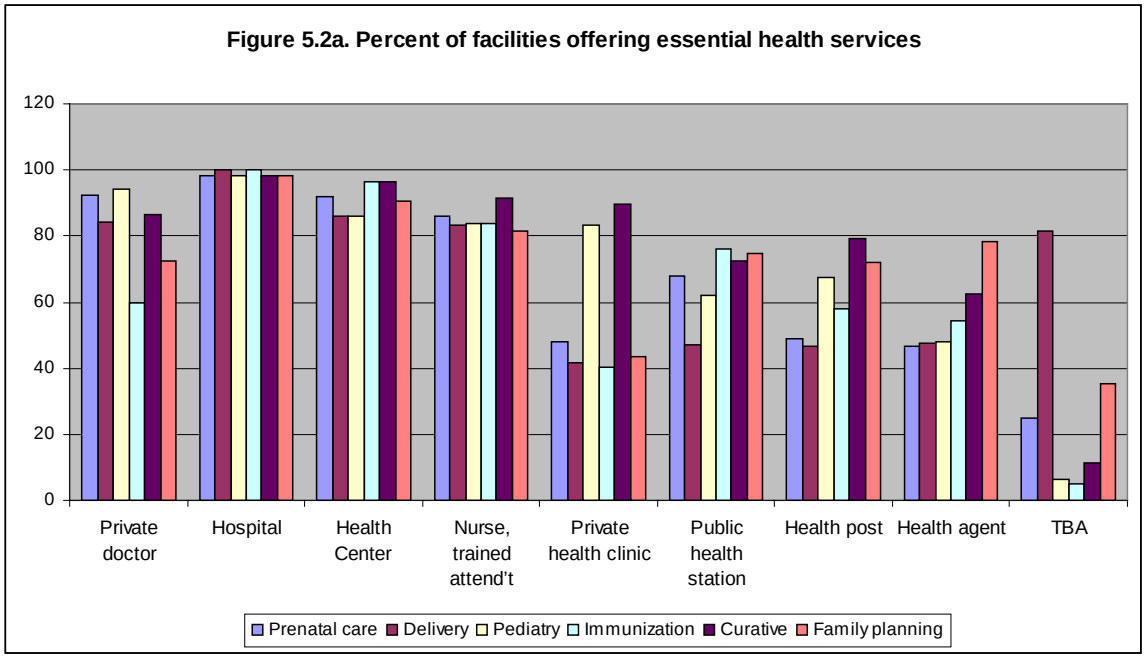
Table 5.8. Percent of health providers that offer essential services and supplies

	Hospital	Health Center	Private health clinic	Public health station	Health post	Private doctor	Nurse, trained attend't	Health agent	TTBA
Availability of essential services									
Prenatal care	98.2	91.9	48.1	67.8	48.8	92.2	86.2	46.7	25.0
Delivery	100	86.0	41.8	47.1	46.5	84.3	83.2	47.4	81.5
Pediatry	98.2	86.2	83.5	62.1	67.4	94.1	83.9	48.1	6.3
Immunization	100	96.5	40.5	76.1	58.1	60.0	84.0	54.4	5.1
Curative	98.2	96.5	89.7	72.4	79.1	86.3	91.4	62.7	11.5
Family planning	98.2	90.7	43.6	74.7	72.1	72.5	81.7	78.4	35.4
Availability of essential drugs and supplies									
ORS	80.4	89.8	79.5	79.1	81.4	73.1	79.8	70.0	15.0
Condom	80.4	84.1	60.3	62.8	60.5	65.4	77.9	61.0	21.0
Antibiotics	83.9	94.3	88.5	76.7	68.2	84.3	86.3	68.3	9.9
Chloroquin	78.6	88.6	78.2	73.3	75.0	76.5	83.0	70.7	8.6

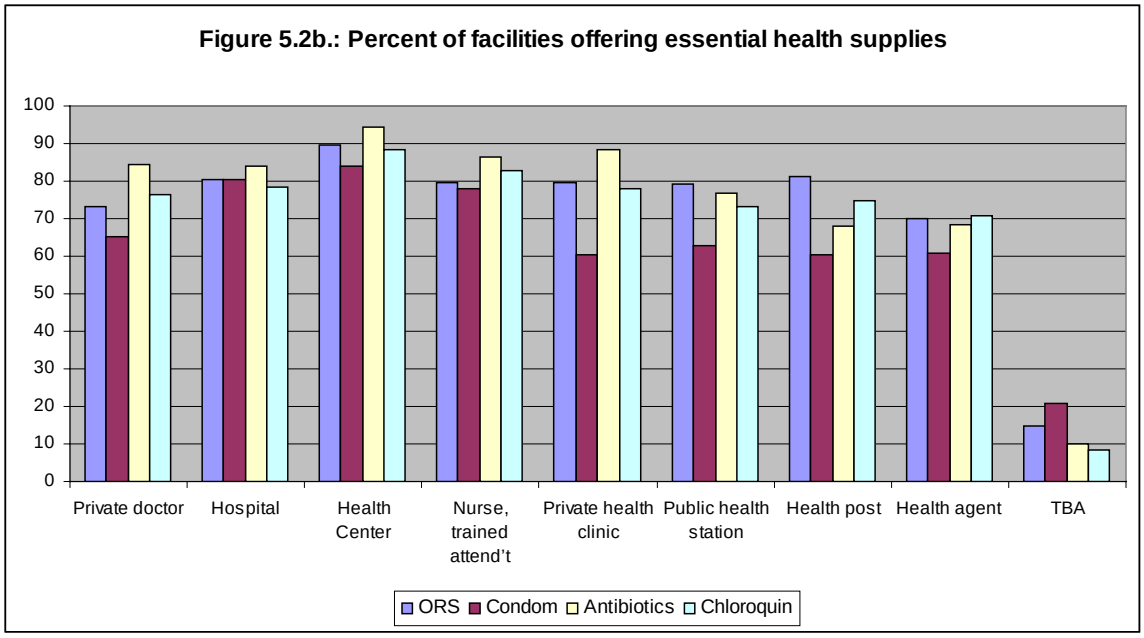
Interesting elements are revealed in Table 5.9. and associated Figures 5.2a and 5.2b. In people's perception, hospitals should offer all types of services. Health centers, private doctors and nurses are also expected to provide a wide array of services, but remarkably, prenatal care, birth delivery, pediatric services and family planning services are not expected to be offered in all health centers, nor by all nurses or trained medical staff. Among services that are decentralized to communities, the expectations are that each type of provider will provide a narrower set of

[11] There appears to have been some confusion in the distinction between public health stations (usually present at the PA level) and health posts (present at the village level). In some areas, the two are the same. This explains why CARE and SC/US list "Not Applicable" as answer.

services, generally of a public health nature: for instance, health agents and rally posts are seen to focus largely on immunization and (to a lesser degree) on family planning; whereas TTBAs are predictably specialized in birth delivery. Notably, curative care and pediatric services are mainly expected to be provided by private clinics—meaning, if one is injured or ill, then medical attention is going to cost something (Figure 5.2a).



A similar picture emerges when analyzing the type of supplies perceived to be available at distinct points throughout the system. Whereas fixed delivery points (hospitals, clinics, dispensaries) are expected to carry the whole set of essential supplies, decentralized units are not expected to carry much in terms of regular drugs (antibiotics, malaria prophylaxis), but they are expected to carry ORS and, also condoms.



Whether those perceptions are true or not, the findings reported above indicate alternative scopes for action: assuming on the one hand that community leaders are correct in saying that certain services are not offered by those prospective providers, then CSs should examine how they could increase the range of skills of the local staff, and how they could better equip them with necessary supplies in their respective domain areas (e.g. train TTBAs on prenatal care, family planning; and provide them with condoms and malaria prophylaxis). If on the other hand the community leaders erroneously assume that those services are not provided by the respective suppliers, then the CSs should better inform villagers about what services are available nearby, and where to get them[12].

Roads and Transportation Services

Road access is generally poor, with only 17% of all localities being within easy reach of the closest town (1.3% via a paved road and 15.9% via a good dirt road). Fully four out of every five communities (83%) can be considered to have difficult access: 37.7% of communities are connected via a transitable but difficult road, and 45%--almost half—only have access via footpaths. Those findings, which represent the overall sample, are faithfully mirrored in each of the five CS areas, as shown in Table 5.10.

Table 5.9. Type of road leading to nearest town (% in parenthesis)

	CARE	CRS	REST	SC/US	WV	Total
Asphalted	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.7)	2 (1.3)
Dirt road, good	4 (12.0)	4 (13.3)	6 (20.0)	8 (26.7)	2 (6.7)	24 (15.9)
Dirt road, poor	7 (22.6)	17 (56.7)	11 (36.7)	8 (26.7)	14 (46.7)	57 (37.7)
Foot path	20 (64.5)	9 (30.0)	13 (43.3)	14 (46.7)	12 (40.0)	68 (45.0)

[12] We do not have information on the quality of services provided at each level. This is unfortunate, as the quality of the service offered is as important as having access to that service.

The most common means of transportation to the nearest town is by foot, pack animal, cart or bicycle (totaling 96% of cases), with motor vehicles being the main means of transportation in only 4% of cases. As expected, this is associated with the type of road: the availability of motorized transportation is restricted to localities having a road. Animal traction or transport on foot is common in most situations, however, no matter the type of access available.

Table 5.10. Most usual means of transportation to nearest town by road type

	Asphalted	Dirt road, good	Dirt road, poor	Foot path	Total
1 Motor vehicle	0 (.0%)	1 (4.2%)	4 (7.0%)	1 (1.5%)	6 (4.0%)
2 Bicycle	0 (.0%)	0 (.0%)	1 (1.8%)	0 (.0%)	1 (.7%)
3 Pack animal, on foot	2 (100.0%)	20 (83.3%)	52 (91.2%)	64 (94.1%)	138 (91.4%)
4 Cart	0 (.0%)	0 (.0%)	0 (.0%)	1 (1.5%)	1 (.7%)
5 Boat, ferry	0 (.0%)	0 (.0%)	0 (.0%)	1 (1.5%)	1 (.7%)
6 Others	0 (.0%)	3 (12.5%)	0 (.0%)	1 (1.5%)	4 (2.6%)
	2 (100.0%)	24 (100.0%)	57 (100.0%)	68 (100.0%)	151 (100.0%)

Conclusions

The findings reported in this section build up an image of communities that stand isolated and are poorly provided with basic services. Most communities in our sample are rural, and are located in the hilly or mountainous terrains (above 1,500m) of the Ethiopian Highlands—except for the Liben/Filtu plateau in the South, where land is flat and elevation is lower. Land is generally under active cultivation, although rangelands are predominant in pastoralist areas of the South while forests occupy large portions of the remote regions of Oromia.

Access to commercial and agricultural services is severely deficient, with distance compounding the poor road access. Access to input and output markets, particularly, is very reduced. Likewise access to health services is poor. Our findings identified a few areas where improvements could be made to increase access to basic health services and supplies. Trained Birth Attendants—the closest source of health information to communities—could be trained in additional skills, particularly in the areas of prenatal care and family planning, which are natural extensions of their current mandate. They could also be used to distribute family planning devices, particularly condoms. Similarly, health agents could be trained to expand their skills in the areas of prenatal care and family planning, as well as ensure more of the distribution of basic supplies such as Vitamin A tablets, iron folate tablets, condoms and malaria prophylaxis.

Chapter Six. Characteristics of the Households and Persons Surveyed

General Description of the Survey Population

This survey collected information on 4636 households. Those domestic units count a total of 25,674 persons between them, making for an average of 5.52 persons per households. The nuclear family[13] is the residential norm: seventy seven percent of all households (3579 of 4636) count only nuclear family members and 93.1% of all persons mentioned are related to the household head either as spouse or as a child. There were very few polygamous households (87 in total, or .3%).

Gender is evenly distributed in this sample, males representing 50.9% of the persons mentioned in the survey and females 49.1% (Table 6.1.). Slightly less than a fifth (18.4%) of all households are headed by a female.

Table 6.1. Gender characteristics of population (% of population)

	Male	Female
Proportion of population	50.9	49.1
Relationship to head		
Head of household	81.6	18.4
First/second wife	0.0	100.0
Son/daughter	54.0	46.0
Son/daughter in law	40.7	59.3
Grandson/daughter	49.2	50.8
Mother/father of head	19.1	80.9
Mother/father in law of head	23.4	76.6
Brother or sister of head	57.0	43.0
Other relative	56.7%	43.3
Adopted child/custody	65.1%	34.9
No relationship	66.7%	33.3
Lives here	87.5%	12.5

The data on the relationship to household head by gender seems to indicate a preference to keep males in the unit—siblings and other relatives of the head as well as adopted children, tend to be male. Patrilocality also appears to be the norm overall: sons tend to stay with their biological parents and to bring in their wife (daughters in law of the head), while female children move out of the home to their husband's family when they marry. This would explain the higher proportion of male over female children in the household.

Education levels are relatively low in our sample. Overall, 65.5% of the people aged 6 years and more for which we have information have no education at all; 22.8% have some primay education (grades 1-6) and 11.7% have reached the secondary level. Those proportions change slightly when considering only the current primary school age population (6-15 years), as the

[13] A nuclear family residential unit is one where only the parents (household heads) and their immediate children live. The presence of other relatives (parents or siblings of household heads, children of children, other relatives) in a household classify it as an "extended family" residential unit.

proportion having no education went down to 63.3% the remainder having received some primary or secondary education.

Table 6.2. Education by gender (% of population)					
	Total[a]			Comparison[b]	
	Both sexes	Male	Female	Male	Female
Education (all over 6 yrs)					
No education	65.5	55.8	75.5	46.6 [c]	53.4 [c]
Some primary	22.8	27.0	18.5	60.9 [c]	39.1 [c]
Some secondary	11.7	17.2	6.1	71.9 [c]	28.1 [c]
Education (only 6-15yrs)					
No education	63.3	60.8	66.0	50.8 [d]	49.2 [d]
Some primary	32.1	33.6	30.5	54.7 [d]	45.3 [d]
Some secondary	4.6	5.6	3.5	60.0 [d]	40.0 [d]

[a]Read down, 100% is column total [b]Read across, 100% is row total
[c]Chi square: 388.899; p=.000 [d]Chi square: 10.487; p=.005

Education is strongly associated with gender: columns 3 and 4, show that many more females received no education (75.5%) than males (55.8%). Notably, however, the differences are less compelling when considering only the school age population: in the younger generation, the proportion of uneducated persons are 60.8% for males and 66.0% for females. This is also expressed when comparing gender composition across education levels (columns 5 and 6, which shows the proportion across gender among the total group in that level): considering all persons over 6 years of age, females appear much less likely than males to have received any education, a situation that worsens as the education level gets higher. When looking only at the current school age population this tendency appears again to have diminished (although we still found significant differences): young females appear nowadays to have almost the same chance of getting into school as young males; they still leave school earlier, however, as males are more likely to reach higher levels than females. In sum, it appears that there has been some improvement in recent years in getting females into school, but there is still room for improvement, particularly in keeping females in school past the first few years.

Table 6.3. Household head status and demographic features by household type

	Male headed HH	Female headed HH
Civil status of household head		
Married	3515 (95.2%)	68 (8.2%)
Single	37 (1.0%)	31 (3.7%)
Divorced, separated	77 (2.1%)	216 (25.9%)
Widowed	65 (1.8%)	518 (62.2%)
Demographic characteristics		
Mean age of household head	45.6	50.8
Mean size of the household by type of HHH	4.81	3.14

The civil status of the head of household (Table 6.2.) is significantly associated with that person's gender: 95% of male heads live with their spouse, whereas only 8% of female heads do so. Females become heads of their household mainly when they are widowed (62% of cases) or

separated/divorced (26% of cases), while male heads rarely live without a spouse, being single, divorced or widowed in only 5% of cases. Female household heads are also likely to be older than male household heads, which may be because most women become heads when they are widowed, which generally happens at a later age in life. The mean number of persons living in female headed households, finally, is also lower than that in male headed units—a fact perhaps explained by the above: female heads being older, their children are more likely to have already left to create their own unit, thus reducing the size of female headed units. As we will see in the Agricultural section, labor is a key constraint to agricultural performance in Ethiopia. In that regard, therefore, female-headed households appear to be disadvantaged. In sum, those results are indicative of female-headed households' different structural position in Ethiopia.

Table 6.4. Religion of the household

	CARE	CRS	REST	SC/US	WV	All
None, atheist	2 (.2%)	2 (.2%)	0 (.0%)	3 (.3%)	0 (.0%)	7 (.2%)
Christian Orthodox	490 (51.8%)	486 (53.7%)	909 (98.9%)	90 (9.7%)	669 (73.8%)	2644 (57.4%)
Islam	451 (47.7%)	414 (45.7%)	10 (1.1%)	757 (81.5%)	237 (26.1%)	1869 (40.6%)
Traditional, animist	3 (.3%)	3 (.3%)	0 (.0%)	79 (8.5%)	1 (.1%)	86 (1.9%)

The predominant religion among sampled households is Christian Orthodox (57.4%) followed by Islam (40.6%). The remaining 2 percent are either non-denominational or follow some animist tradition (Table 6.3.). These proportions vary substantially between CSs, however. Whereas household religion in the CARE and CRS areas appear to be generally representative of the overall sample (and of the religious mix in the country), the units in the REST area are overhwelmingly Christian Orthodox (98.9%); while those in the SC/US area are predominantly Muslim (81.5%). Households in the WV area also tend to be more of a Christian faith than the overall sample. We are obviously not posing any judgment here on a CS's choice of area or households—those proportions simply represent the particular composition of the population in their areas of work. But such differences may matter in terms of programming, and the CSs must take that into account where and when it matters.

Socio Economy of the Household

In this subsection, we describe the household physical structure, the water and sanitation conditions at the household level, the equipment used in the home, and the domestic and productive assets owned by the household. The section ends with the elaboration of three indices representing different dimensions of the household's socio-economic and material status, after which we return to some of the data presented above and examine whether wealth has any incidence on the distribution of female headship, employment, education, and other issues.

Household Physical Structure and Access to Utilities

Floors in most households are made of packed earth, sand or stone (98.2% of cases). Walls and roofs, by contrast are build wth a variety of materials, much of this depending on the area, the climate and the locally available materials, as suggested by the important differences betweeen CSs in this respect. Most homes (84.3%) have 1 or 2 rooms (an animal pen located inside the home was considered a separate room); and most (79.6%) have 1 or 2 closed, covered building (a barn, an external kitchen, were considered separate buidlings). The homestead and the plot where the homestead is located are owned by the occupants in more than 90% of cases (see Table 6.5).

Table 6.5.: Characteristics of the home (all figures are in percent)

		CARE	CRS	REST	SC/US	WV	Total
Description of home							
Type of home	Hut (one materials)	2.6	2.0	15.8	66.3	19.1	21.3
	Hut (different materials)	85.1	86.0	74.0	30.1	65.7	68.1
	Tin roof house	12.1	11.8	7.8	2.8	8.3	8.6
	Other	.2	.2	2.4	.8	6.9	2.1
Floor materials	Earth, sand, stone	98.0	98.7	98.4	99.5	96.4	98.2
	Concrete/cement	1.1	.9	1.0	.5	1.1	.9
	Wood	.7	--	--	--	2.4	.6
	Mosaic/ceramics	.1	.1	--	--	.1	.1
	Others	.1	.3	--	--	--	.2
Wall materials	Mud/clay	2.0	1.8	23.8	16.5	5.1	9.8
	Canes/stalk	1.5	1.0	.5	63.1	15.9	16.5
	Stalk with mud/dung	33.9	48.4	.1	16.6	7.3	21.2
	Wood	45.7	2.8	2.1	1.3	34.1	17.4
	Zinc	.4	.1	.7	--	--	.2
	Concrete block/brick	--	.2	--	.2	.1	.1
	Other (including stone)	16.5	45.7	72.8	2.4	37.5	34.7
Roof materials	Mud/clay	.5	.8	4.8	1.4	.9	1.7
	Cane/stalks	78.1	38.7	17.7	80.5	48.3	53.0
	Stalk with mud/dung	1.0	5.5	.9	.4	1.2	1.8
	Wood	1.5	1.2	22.5	5.8	1.5	6.5
	Zinc	18.9	15.9	16.3	6.4	13.1	14.1
	Concrete block/brick	--	--	--	.2	--	--
	Other	.1	37.9	37.8	5.3	34.9	22.9
N of rooms in home	One or two	88.2	81.9	73.0	97.1	81.0	84.3
	Three or more	11.8	18.1	27.0	2.9	19.0	15.7
N of covered buildings	One or two	92.7	89.7	51.0	88.6	73.7	79.2
	Three or more	6.5	10.3	43.5	6.4	26.1	18.4
Tenure of home	Ownership	96.8	94.8	90.0	84.9	93.2	91.9
	Rent	.6	1.2	1.1	2.6	1.9	1.5
	Duty residence	.5	1.2	.3		.1	.4
	Free occupation	2.0	2.8	8.5	12.5	4.9	6.1
Own plot where home is located		93.3	92.8	88.8	82.3	94.3	90.3

The most common lighting method used in the homes is the kuraz lantern (69% of homes) while another 11.3% uses the more sophisticated *fanos* and *masho* lanterns. Those lanterns all use kerosene, a good sign that less environmentally damaging energy sources are already available widely in the countryside. Firewood is used in 17.4% of homes overall as a source of light, but this average is made higher due to its wide use in the SC/US area (56.9% of homes). Other CS areas use it very little for lighting purpose. As to the source of energy for cooking, the main one remains firewood (81.5%), followed by dung (17.7%). Kerosene is still extremely rare, and no gas is reported.

Table 6.6. Sources of energy used in the home

		CARE	CRS	REST	SC/US	WV	Total
Lighting method	Dung	4.2	.2	.3	.6	1.4	1.4
	Firewood	14.5	1.9	4.6	56.9	8.3	17.4
	Kerosene (kuraz lantern)	73.8	89.4	92.5	6.2	84.3	69.0
	Fanos or Masho lantern	7.4	8.4	2.3	35.8	2.4	11.3
	Electricity	--	.1	.3	.2	3.5	.8
Cooking fuel	Dung	26.3	7.4	18.2	.3	36.1	17.7
	Wood	71.2	92.5	81.6	98.6	63.6	81.5
	Charcoal	--	.1	.1	1.1	--	.3
	Kerosene	.6	--	--	--	.1	.2

Water and Sanitation Systems

We examined the water situation in detail, looking at access and availability during the rainy and dry seasons. Results show that very few people (3.8% overall) have access to protected water for their drinking needs, no matter the time of year. Looking at the rainy season for instance, the main source of drinking water for most of the population (96.2%) is unprotected (it comes from surface or sub-surface water in 62.5% of cases, and from unprotected public or private taps in 33.7% of cases). Those proportions change little during the dry season, although curiously people seem to have slightly better acess to water from protected sources in the dry season than in the rainy one. The reason for this may be found in the next Table where we look at the time it takes to fetch drinking water.

Table 6.7a. Source of drinking water during rainy vs. dry season (main source only)

	CARE	CRS	REST	SC/US	WVE	Total
Rainy season						
Non-protected source, surface water*	71.0	60.9	52.7	76.3	53.2	62.5
Non-protected source well or tap**	27.5	33.3	42.4	22.2	41.9	33.7
Protected source***	1.5	5.8	5.1	1.5	4.9	3.8
Dry season						
Non-protected source, surface water*	72.1	53.0	48.6	57.6	49.4	55.3
Non-protected source well or tap**	26.9	39.7	45.7	38.5	44.9	39.8
Protected source***	1.1	7.3	5.7	3.9	5.7	4.9

* Includes surface water (e.g. river), sub-surface water, pond, lake, canal.
** Includes home/yard tap, public/neighbor tap, open well in homeyard, public open well, purchased water
*** Includes protected homeyard tap, protected well in homeyard, protected public/neighbor tap

Respondents were asked about the time it takes to fetch drinking water, comparing again between the two main seasons of the year. During the rainy season, people overall spend about half an hour one way (27.1 minutes) to reach the drinking water point during the rainy season[14]. The time it takes to fetch drinking water during the dry season is more than double, averaging 65.4 minutes. The effect of the dry season is hard on everyone but particularly for the population in the SC/US intervention area, where the average goes from 42 minutes during the rainy season, to more than three hours (195 minutes) in the dry season. People in that region who have access only to non-protected surface water have to travel even farther (more than four and a half hours).

Table 6.7b Time in minutes to fetch drinkng water by season

	CARE	CRS	REST	SC/US	WVE	Total
Rainy season						
Non-protected source, surface water	28.2	39.9	24.5	42.0	16.8	31.5
Non-protected source well or tap	14.5	26.7	19.8	41.5	13.1	21.8
Protected source	11.5	20.1	33.6	24.7	14.6	22.4
All sources	21.2	35.0	23.0	41.6	15.0	27.1
Dry season						
Non-protected source, surface water	34.7	61.0	36.9	275.7	23.6	92.4
Non-protected source well or tap	15.8	49.4	22.1	94.4	19.9	41.5
Protected source	8.6	29.3	33.0	104.1	37.1	42.5
All sources	26.0	52.8	29.9	195.1	22.2	65.4

The questionnaires also collected information on the quantities of water consumed by people, comparing between three moments in time, namely: the day before the interview; during the rainy season; and during the dry season (Table 6.7c). Here again, findings are puzzling as people reported fetching larger amounts of water during the dry season than during the rainy season. Although unexpected this result may be explained by the fact that people may need to fetch less water during the rainy season: they are more likely to catch water domestically during the rainy season; they may also consume less of the fetched water for cleaning and washing[15].

Table 6.7c Average quantities of water fetched by season (liters)

	CARE	CRS	REST	SC/US	WVE	Total
Drinking water						
Yesterday	19.7	25.2	24.6	34.2	22.3	25.2
During the rainy season	20.6	25.6	24.1	42.7	22.8	27.2
During the dry season	26.4	33.9	30.4	34.0	26.5	30.2
Cleaning/washing water						
Yesterday	7.2	37.0	28.3	25.0	16.8	22.4
During the rainy season	34.5	44.9	32.8	50.5	21.0	36.9
During the dry season	38.7	53.2	35.9	40.2	23.9	38.5

[14] One notes that. aside from REST, the safer the source, the closer it is to home (although the reverse is obviously not true). Since women and children are the main water bearers in Ethiopia, safe water systems appear to provide the additional benefit of reducing the time spent doing this demanding chore.

[15] Note however that the data for "yesterday" is consistently lower than that in either of the two seasons. That the survey took place at the end of a dry season, during a drought year may have affected the data.

The extent to which this amount of water is sufficient to provide the various members of the household with their daily needs is examined in the next Table. Before doing so, however, we discuss briefly the international standards against which the situation in our sample is compared. According to Gleick (1996), a reasonable target for per capita consumption in developing countries is 50 liters of water per capita per day (lcd) (as a comparison, the actual per capita use in the US is between 246 and 295 lcd, depending on the study cited). The Gleick figure includes a minimum of 5 lcd for drinking water, 15 lcd for bathing, 10 lcd for food preparation, and 20 lcd for water and sanitation. The sum of those quantities is in line with the standard of 20 to 40 lcd set by USAID, the World Bank and WHO, who exlcude water for cooking and cleaning. According to Billig et al (2001), this standard may have to be adjusted downward based on consideration of availability, climate and technology used, but it provides a general guideline against which to compare the current situation and/or establish program goals.

In our Ethiopian sample, the mean water consumption per day during the rainy season was 13.6 lcd; and 14.8 lcd during the dry season. The proportion of needs covered is therefore 27.2% in the rainy season and 29.5% in the dry season[16]. As we said above, some adjustments may be needed to accommodate for local conditions, yet those figures are well below any acceptable level. This is a key area for programming. We examine the effects that water access has on child health in Chapter 12.

Table 6.7d Average quantity of water consumed per household and per capita by season

	CARE	CRS	REST	SC/US	WVE	Total
During the rainy season						
Drinking water cons. by HH	20.7	25.3	24.0	42.8	23.0	27.2
Washing water cons. by HH	35.6	45.1	34.4	50.8	23.8	38.4
Total water cons. by HH	55.0	68.2	54.9	92.9	43.2	62.9
Total water cons. per capita	12.1	15.8	13.3	16.4	10.4	13.6
% of water needs covered	24.3	31.7	26.6	32.8	20.8	27.2
During the dry season						
Drinking water cons. by HH	26.6	33.7	30.2	34.2	26.7	30.2
Washing water cons. by HH	40.0	53.6	36.9	41.0	26.4	39.9
Total water cons. by HH	64.9	84.5	63.8	74.0	49.5	67.4
Total water cons. per capita	14.3	19.6	15.3	12.7	11.9	14.8
% of water needs covered	28.6	39.2	30.7	25.5	23.9	29.5

Table 6.8a. finally, presents subjective data on perceptions of availability, compared to the previous year. Overall, half (50.5%) of households said that there was less water the year of the survey than the previous year; about a quarter (22.6%) said there was more water available; and the remainder (26.9%) saw no change in availability. This varies by CS area, however: a greater proportion of households in the CARE and REST areas reported a reduction in water availability compared to the previous year, while more households in the SC/US areas reported improved availability. The latter may be due to the work done by SC/US under the previous DAP, which

[16] The drought may have affected those figures. This may explain the fact that the SC/US numbers are higher in the rainy season: the Liben/Filty area was less affected than the others by the 2002-2003 drought.

had an important water systems component. The SC/US area was also less affected by the drought.

Table 6.8a. Water availability compared to last year in 3 most critical months of the dry season by CS intervention area (% households)						
	CARE	CRS	REST	SC/US	WVE	Total
Availability improved	5.1	26.9	12.0	51.4	17.4	22.6
Availability deteriorated	76.2	34.3	66.4	26.1	48.9	50.5
No hange in availability	18.7	38.8	21.6	22.5	33.6	26.9

In our view, however, that latter comparison is unreliable: households were asked to compare between two very bad years as drought affected localized portions of Ethiopia in both 2002 and 2003. For that reason, we further broke down the information by socio economic zone (Table 6.7b); and that seems to have cleared the picture somewhat: people in South Gondar and Wello, Tigray and East/West Hararghe (areas of great water stress in 2002-2003), all reported an important deterioration in the availability of water for human consumption; whereas DireDawa, Liben/Filtu and East Shoa (where programs were active in former years, and where the drought was felt less badly, except in DireDawa[17]) saw improvements in water availability.

Table 6.8b. Water availability compared to last year in 3 most critical months of the dry season by Socio Economic Region (% households)								
	E/W Hararghe	E Shoa	Liben/ Filtu	South Gondar /Wello	Tigray	Dire Dawa	Gamo Gofa	Total
Availability improved	10.1	47.1	51.4	7.0	11.1	100.0	46.0	22.6
Availability deteriorated	54.4	10.3	26.1	65.7	67.7	0	4.0	50.5
No hange in availability	35.5	42.6	22.5	27.3	21.2	0	50.0	26.9

Access to domestic sanitation amenities is scant. Almost nine of every ten households (87.5%) uses no measure whatsoever for disposal of feces. Most households who use some form of sanitation defecate in a non-structured site, usually a hole located out in the open and with no walls or privacy. Only 2.3% of households have access to pit or VP latrines. Those who have access to a latrine rarely share it (except in the SC/US area, where this seems to be accepted). Observations of the latrines that exist reveal that the majority of households who have latrines use them but do not keep them clean, therefore not entirely eliminating the risk of disseminating pathogens in the environment.

Environmental sanitation is also an issue. Work is needed to teach proper garbage disposal methods to households and communities. The majority of families (almost 90%) just throw their garbages out in the nature, whether close to the home or far away. Simple methods of garbage disposal, such as burrying or burning could be promoted to reduce the risk of contaminating the environment. Else, CSs could work with the *Kebele* to establish a community dump site, accompanied by education and awareness campaigns to increase people's use of those sites.

[17] Note that only 62 households were sampled from DireDawa.

Table 6.9. Sanitation in and around the household							
		CARE	CRS	REST	SC/US	WV	Total
Latrine type	None/in the bush	92.4	88.1	90.2	87.4	79.2	87.5
	Hole, no walls	5.4	7.9	8.7	11.4	17.7	10.2
	Improved pit latrine	1.0	3.1	.4	.5	2.5	1.5
	VP latrine	1.3	.9	.7	.6	.6	.8
Is latrine shared w/other households (n=520)?	Yes	22.0	16.7	30.9	67.3	94.0	26.3
	No	78.0	83.3	69.1	32.7	6.0	73.7
Observation of latrine (n=520)	Not used	7.6	3.2	15.5	2.6	3.8	5.5
	Used but dirty	48.5	33.0	33.8	50.0	74.6	53.2
	Used and clean	40.9	63.8	50.7	47.4	17.8	39.6
Garbage disposal	None produced	.1	--	2.1	2.0	.1	.9
	Out close to home	68.6	62.8	47.6	35.8	39.2	50.8
	Out far from home	23.5	32.7	36.8	46.8	50.2	37.9
	Community dump	.5	.3	.4	1.2	.2	.6
	Bury it	1.2	3.0	6.2	3.4	2.6	3.3
	Burn it	.2	1.2	.4	10.4	.8	2.6

Domestic and Productive Assets

In this section we initiate the construction of a household indicator of wealth. Deriving a socio economic indicator that assesses the wealth situation of the household is a crucial element for the type of analysis to be presented later in this report. This is because a household's socio economic status (wealth) is usually associated with a number of outcomes, whether nutritional, agricultural or others. It is thus important to have a good measure of the socio economic situation of the household, so we can control for the effect of that variable when attempting to explain an outcome of interest.

Wealth, or socio-economic status, is usually measured by collecting income data, consumption data, and/or data on the material assets available to a household. However in developing countries where income sources are multiple and often informal, it can be difficult to arrive at a precise measure of income. Likewise consumption surveys are complex, time consuming and have a fairly narrow utilization besides that of establishing a measure of wealth. By contrast, collecting data on the material assets available to the household is relatively straightforward and can provide reliable measures of wealth. There are a few drawbacks associated with this type of indices, however: first, they may represent only a particular form of wealth—that which is visible to the observer—while ignoring other forms that are constitutive of wealth such as savings or social networks (but note that this is also true of income surveys). Second, no ready standard exists to determine which types of possessions should enter the final index—the "must-have" tools needed to produce, for instance, will differ between grain-producing and coffee-producing regions. Too much heterogeneity in asset ownership across regions may further complicate the analysis as the components of the final index then have to be derived anew for each region. Third, asset-based indices derived from the characteristics obtained in a particular sample provides only a relative measure of wealth (contrary to income or consumption data), which is only valid for that particular sample: the distribution of the index being contingent (i.e. the wealthiest person in the sample of reference may be considered poor in another sample) the

index does not mean anything outside of the specific context where it was elaborated. In order to assess the extent to which those problems affect us here, we first analysed how the various assets owned by household units in Ethiopia are distributed across the five individual CS samples. Data was collected on the ownership of consumer items such as watch, radio and furniture, and on productive assets such as tools, livestock and land and an index of asset ownership was computed using the value of each asset as reported by community informants during a focus group. Those indices are then used in the elaboration of an overall socio-economic index aimed at stratifying the population into wealth categories.

In the set of Tables that follow, the values in the cells represent the proportion of households that own one or more of the item listed in the leftmost column, with items listed in decreasing order of frequency of ownership (rightmost column). The last line in each Table presents the mean asset index for that type of goods by CS area. In addition to offering a preliminary idea of the variation there is in asset ownership across CS areas, those Tables confirm that the distribution of ownership of each item is quite homogenous across the five samples, suggesting that the individual indices (domestic assets, tools and livestock) can safely be combined to build an overall Socio Economic Asset index.

Table 6.10a. Ownership of consumer assets (% of HHs that own)

	CARE	CRS	REST	SC/US	WVE	Average
Kettle, tea pot	53.1	66.0	6.6	85.8	17.7	45.5
Trunk/box for safe storage	27.5	41.4	14.3	34.7	22.2	28.0
Watch, clock	21.4	22.0	16.7	38.5	18.8	23.4
Radio	15.1	18.5	18.5	24.4	12.7	17.8
Bed (wood)	16.2	2.6	2.0	13.7	20.7	11.3
Table	9.5	4.4	2.5	27.6	8.1	10.5
Chair	5.9	13.1	4.3	19.4	8.9	10.3
Bed from animal skin	7.6	1.8	3.3	26.5	5.6	10.0
Cassette/CD player	4.0	4.6	2.9	8.5	5.8	5.1
Gas/fuel efficient stove	2.6	12.6	6.5	.8	1.9	4.8
Bed (metal)	4.0	6.3	2.4	3.9	6.1	4.6
Cupboard	6.3	3.7	1.2	5.0	4.4	4.1
Bicycle	.1	.9	.1	.8	.1	.4
TV	.2	.5	.2	.6	.5	.4
Motor vehicle (car/motorbike/tractor)	.1	.3	.3	.3	.3	.3
Mean household asset index*	215.91	194.55	95.11	299.60	229.28	207.12

*The household asset index value is the sum of each item owned by the household, multiplied by its relative value. The modal value of that item was used as multiplier[18]. The modal values applied were, in Ethiopian Birrs: Kettle/tea pot, 10; Trunk/box for safe storage, 60; Watch/clock, 10; Radio, 100; Bed (wood), 170; Table, 30; Chair, 25; Bed (animal skin), 50; Cassette/CD player, 300; Fuel efficient stove, 60; Bed (metal), 300; Cupboard, 1500; Bicycle, 700; TV, 1500; Motor vehicle, 5000.

[18] This modal value was obtained through a focus group with community informants, held in each cluster visited. The value of each item listed in Tables 6.10 was assessed during that exercise.

Table 6.10b. Ownership of tool assets (% of HHs that own)	CARE	CRS	REST	SC/US	WVE	Total
Axe	65.4	71.7	69.8	75.1	71.6	70.7
Plowyoke	59.0	61.8	80.1	34.4	59.0	58.8
Plowbeam	59.2	60.9	77.7	28.7	58.7	57.0
Hoe	24.2	42.1	60.4	56.6	39.1	44.4
Spade	37.1	40.6	34.8	33.6	19.9	33.2
Shovel	46.4	48.8	29.3	16.3	19.7	32.1
Pick	32.4	31.4	17.9	37.1	28.0	29.4
Thresher	20.9	33.3	68.5	0.9	20.1	28.6
Machete	9.1	29.1	48.4	30.9	5.8	24.6
Sickle	28.9	21.4	11.5	17.7	11.5	18.3
Bucket	8.0	12.2	9.5	18.3	5.1	10.6
Weeder	9.1	3.2	1.3	9.6	9.0	6.5
Sledgehammer	1.9	8.2	6.4	7.7	5.0	5.8
Mencha	8.7	3.3	0.8	0.0	0.1	2.6
Handsaw	1.2	0.8	2.3	5.9	0.9	2.2
Sprayer	2.0	2.9	1.3	3.1	1.2	2.1
Cart	0.7	4.5	2.2	2.3	0.3	2.0
Veterinary kit	0.1	0.8	0.3	4.0	0.2	1.1
Plough	0.0	0.0	3.7	0.0	0.0	0.7
Motorpum	0.3	0.4	0.5	0.4	0.2	0.4
Dengora	0.2	0.1	1.0	0.1	0.4	0.4
Handpump	0.2	0.3	0.3	0.4	0.2	0.3
Weaving tool	0.6	0.1	0.2	0.1	0.1	0.2
Mean tool asset index*	164.21	181.77	263.24	137.84	140.14	177.27

*The tool asset index is a sum of the number of each tool owned by the household multiplied by the assessed value of this tool. The mode of the value was used as multiplier. The following values in EB were applied: Axe, 15; Plow yoke 10; Plow beam 25; Hoe, 10 Spade, 14; Shovel, 15; Pick, 15; Thresher 10; Machete, 15; Sickle, 12; Bucket, 22; Weeder, 5; Mencha, 30; Sledgehammer, 35; Handsaw, 30; Sprayer, 10; Cart, 35; Veterinarian kit, 25; Plough (Maresha) , 15; Motor pump 5000; Dengora, 15; Hand/foot pump 320; Weaving tools, 30.

Table 6.10c. Ownership of livestock assets (% of HHs that own)	CARE	CRS	REST	SC/US	WVE	Total
Oxen	41.2	44.7	66.6	34.2	48.1	46.9
Bull	12.8	7.2	22.6	26.3	10.6	15.9
Milk cow	39.5	37.8	25.5	59.4	36.1	39.7
Other cow	13.7	16.9	18.7	37.0	13.5	20.0
Heifer	21.6	18.0	14.5	29.5	15.8	19.9
Calve	35.9	30.5	27.1	55.9	32.9	36.5
Sheep	29.4	27.4	6.6	21.2	26.9	22.3
Goat	20.6	27.0	25.0	58.1	15.7	29.3
Donkey	26.2	32.4	27.6	30.3	27.7	28.8
Mule	1.3	0.8	0.9	0.8	2.6	1.3

Table 6.10c. Ownership of livestock assets (% of HHs that own)						
	CARE	CRS	REST	SC/US	WVE	Total
Horse	10.1	0.2	0.5	0.3	2.9	2.9
Lactating camel	0.0	0.8	0.3	26.5	0.0	5.5
Other camel	0.3	2.3	1.3	26.3	0.5	6.2
Chicken	26.6	45.9	49.3	19.4	39.7	36.1
Beehives	3.5	7.9	11.8	5.4	5.7	6.8
Mean livestock asset index*	1579.83	2018.00	1894.75	6991.90	1856.78	2889.91

**The livestock asset index is a sum of the number of each animal owned by each household at the time of the survey multiplied by the unit value of this animal. The unit value per animal was obtained from the EU's price monitoring unit, which maintains monthly statistics on the price of various items in various regions in the country.

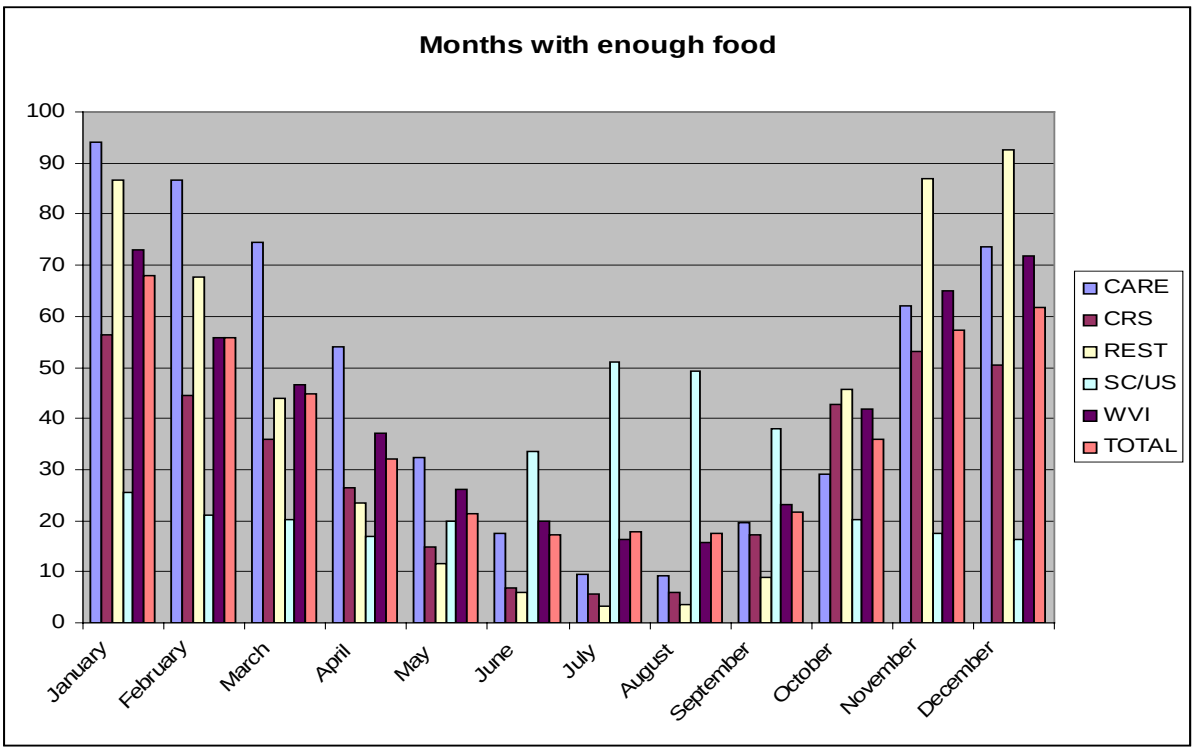
The information contained in Tables 6.10a, b and c is not examined in further detail here, as what matters really is the overall asset index derived from the ownership of various items. As such this data will be important in the calculation of the household wealth index, presented later in this chapter. Before doing this, however, a few more univariate statistics will be presented concerning the relative food security situation of the households visited during this survey.

Food Security Situation of the Households

Respondents were asked about their food security situation. A first set of questions asked whether they had enough food to cover their needs for the whole reference year (2001-2002), and on a month by month basis. Their responses are presented in Table 6.11 and Figure 6.1.

Table 6.11. Access to Food during 2001-2002 year						
% of HHs that had enough food to cover all needs	CARE	CRS	REST	SC/US	WV	All
During all of last year	15%	6%	9%	11%	25%	13%
In January	94.0	56.3	86.5	25.4	73.1	67.9
In February	86.5	44.6	67.8	21.0	55.7	55.8
In March	74.6	35.8	43.8	20.2	46.5	44.8
In April	54.1	26.3	23.4	17.0	37.2	32.1
In May	32.3	14.8	11.6	20.0	26.2	21.4
In June	17.4	6.9	5.8	33.6	19.8	17.1
In July	9.5	5.5	3.4	51.1	16.3	17.9
In August	9.3	5.9	3.6	49.3	15.8	17.5
In September	19.5	17.3	8.8	38.0	23.1	21.8
In October	29.1	42.8	45.8	20.2	41.9	35.9
In November	62.1	53.1	87.0	17.4	64.9	57.3
In December	73.7	50.4	92.7	16.3	71.9	61.7
Mean n of months with enough food	**5.4**	**3.3**	**4.5**	**3.0**	**4.8**	**4.2**

Figure 6.1.

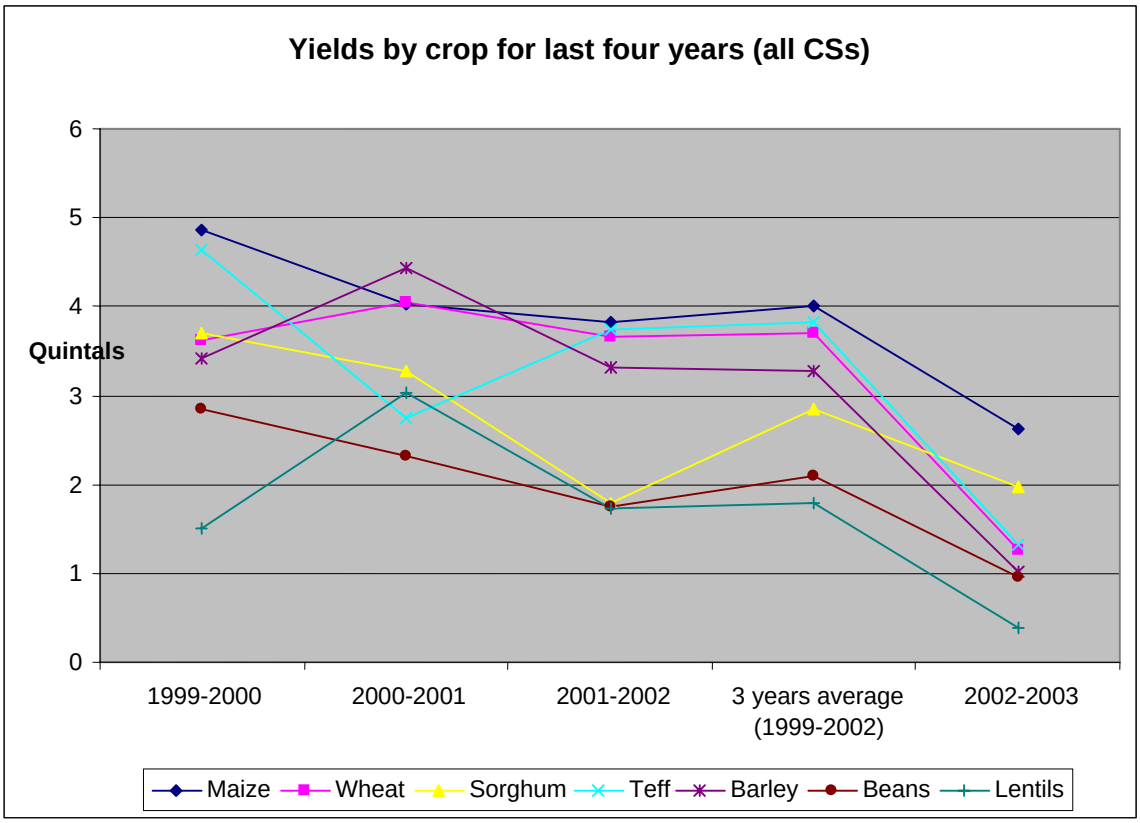


According to this data only 12.5% of all households had enough food to eat at all time during last year. Thus the great majority of households suffered from food insecurity at some point during the year. The months of greatest shortage are the months of April to October; the months with greatest access to food are from November to January[19]. In no month is there more than 68% of all households having enough to eat and households on average had enough food to satisfy only 4.2 out of the 12 months of the year (this varies somewhat by CS but the trends are quite similar overall).

As we already mentioned, the year under review was particularly difficult due to the severe drought conditions that affected large portions of Central and Eastern Ethiopia. Farmers were asked about their agricultural performance by crop, compared to the last three years of production, and it seems clear from their responses that they had to face very severe reductions in food production during the target year. Production of all main food crops was half or less that recorded in the 1999-2000 agricultural season (itself considered a bad year); the decline from the average three previous years is precipitous, particularly for wheat and teff, although maize and sorghum are also hard hit, as well as beans and pulses.

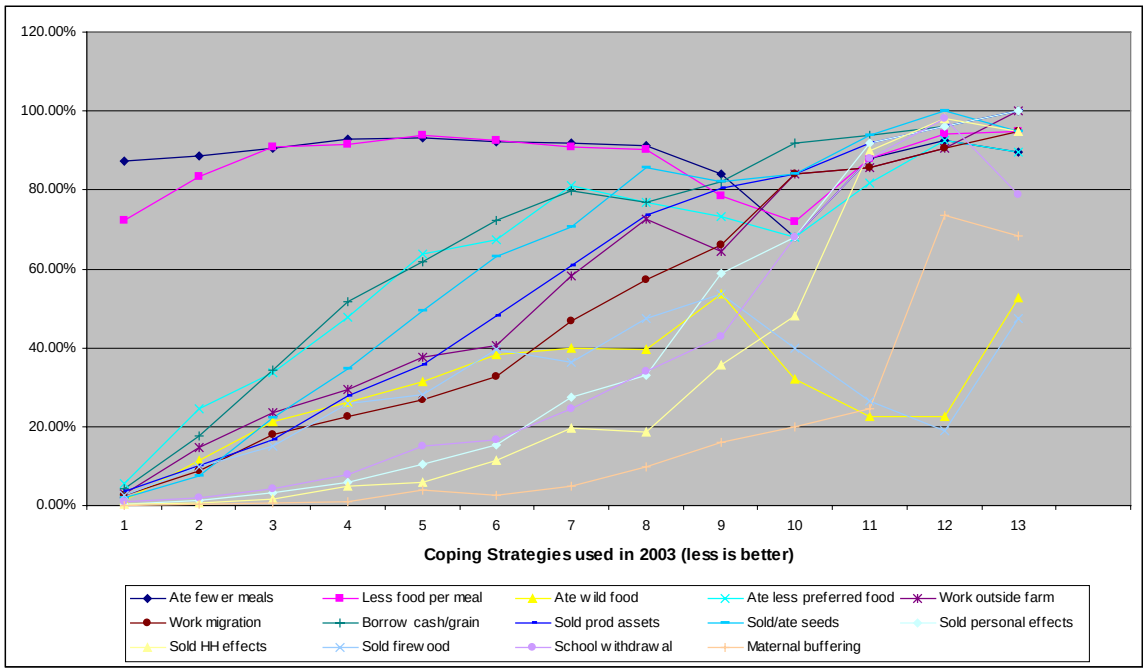
[19] However, note from Figure 6.1. how access to food in the SC/US intervention area appears to be exactly the reverse as in other CS areas: whereas the summer months (May to October) are clearly the most difficult ones for households in the CARE, CRS, REST and WV areas, those are the best ones (in relative terms) for the pastoralists area served by SC/US. This is not so much related to a different meteorological system as to a profoundly different livelihood system and a different food economy.

Figure 6.2.



How do people cope with such a severe situation? To explore that question, we list below in Figure 6.2 the various coping strategies that were used by the household during that year.

Figure 6.3.



We can classify the actions taken by people to cope with stress and food insecurity into three degrees of severity, as follows:

(1) People's first and most common way to cope with food insecurity is to reduce food intake, either by reducing the number of meals or reducing the quantity of food in each meal. Consuming inferior foods is also very common. Ninety percent of households in our sample resorted to one or more of those three strategies. We define this first stage in the severity of coping as "tightening the belt". Those who answered yes only to those items were the ones least affected by food insecurity.
(2) The next degree is represented by a set of practices that, while apparently unrelated, empirically cluster closely together. These include selling firewood, borrowing cash or grain, migrating for work or work outside the farm. Although dissimilar in appearance, all those imply reaching out and using unusual means to obtain income or food from sources outside the farm. We thus refer to this second stage of coping as "reaching out".
(3) The next stage in coping, the most severe one, is when people start selling assets. This is well represented in the graph by the set of lines closest to the bottom, showing that people usually delay this type of strategy as long as possible. When no other choices remain, however, they begin to sell household assets, personal effects or productive assets. They may also eat wild (often poisonous) foods; and maternal buffering. We refer to this third degree of coping as "divesting".

In general, our data confirms our theoretical expectation of coping as a ratcheting process: people begin by tightening consumption. When this is not enough, they reach out to their social networks or to the market to generate additional income or food. When these possibilities also get exhausted, they begin divesting. The logical consistency of this argument is solid; and it is consistent with theoretical work of Frankenberger, et. al. (1994), and Maxwell and Frankenberger (1992) on the concept of "coping".

Creation of the Household Socio Economic Indices

To better understand what determines a particular household's level of food insecurity, as well as several other dimensions this survey is interested in—agricultural performance, child nutritional status, etc—it is important to have a means of assessing households' wealth. As we well know, however, the elements that are constitutive of wealth are diverse and it can be challenging to bring all those elements together in a single index that will accurately represent the aggregate socio economic status of the household. This is further complicated when the socioeconomy of the households under consideration are heterogenous, like in our sample: the elements of wealth in Tigray, for instance, may be very different than those in the Liben/Filtu area. Fortunately, some statistical techniques can be used to help determine which aspects should be included in the final index. After considering several approaches, including a World Bank method developed by Gwatkin et al (2000); and a standard Guttman scaling procedure; we decided that a Factor Analysis using Varimax rotation provided the best approach for data reduction in our sample. Furthermore, we decided to derive a different index for each one of the socioeconomic zones found in the CS intervention areas. The seven zones previously described in Chapter 4 (East & West Hararghe, South Gondar & Wello, Tigray, East Shoa, DireDawa, Liben & Filtu and

GamoGofa) were treated individually by the Factor procedure, to produce region-specific factor scores. This ensures that the scores attained by any household is specific to the context in which it finds itself.

The types of assets we initially considered for inclusion in our index of household wealth included the ownership of the consumer items listed earlier (radios, TVs, beds, chairs, etc); the type and quality of the home (number of rooms and buildings as well as the materials used in the roof, walls, floor); household equipment (water and sanitation, lighting, cooking means); and the ownership of productive items (tools, land, livestock). All those were included in the initial Factor Analysis runs. Several iterations were made, leading to the progressive rejection of those indicators that were weakly associated with the emerging principal components. Rejected indicators include: form of garbage disposal; type of access to drinking water; type of cooking fuel used; ownership of the home; type of home; and the index of domestic assets. The items retained in the final matrix include land holdings, animal assets, and tool assets. In all regions, those items showed very strong association with a common, underlying dimension we hypothesize to represent "household socio economic status". Table 6.12 presents the factor loadings of these variables by region.

Table 6.12.: Rotated Component Matrix[a] for Household Wealth Factor

Factor loadings for→ In ↓	Land assets	Animal assets	Tool assets
East & West Hararghe	.527	.811	.805
South Gondar & Wello	.863	.846	.870
Tigray	.763	.462	.842
East Shoa	.651	.785	.802
DireDawa	.527	.792	.845
Liben & Filtu	.719	.743	.752
GamoGofa	.797	.827	.714

[a]Extraction Method: Principal Component Analysis. Rotation Method: Varimax

A few comments are in order to explain why we left the Domestic Assets Index (DAI, which summarizes ownership of watch, tables, chair, radio, etc) out of the final solution. First, unlike the three indicators we retained in the end, this index loaded unevenly with the main component in several of the socoeconomic regions. Its inclusion therefore increased the total amount of variance in the rotation, but contributed little in explaining away this variance. Second, the initial factor runs—which included all the variables initially hypothesized to constitute wealth—tended to systematically separate the DAI from the core three ones above. On the other hand it associated (albeit weakly in some regions) with other measures of wealth that pointed more at the cash liquidities in the home (such as source of cooking fuel), than at the basis of wealth itself. Our conclusion therefore was to use the three household scores to generate the procedure described in Table 6.12. We will still use the DAI, but independently and as a proxy for the availability of liquid assets.

In the next section, a bivariate analysis is performed to further validate the socio-economic status index and to derive hypotheses about its possible effect on some of the demographic variables explored earlier in this chapter.

Effect of the Wealth Index on Demographic and Economic Factors

Three socio-demographic variables, namely, gender of the head of household, age of the head of the household, family size, and level of income diversification, were examined in relation to the domestic wealth index derived in the previous sub-section. A few variables related to household equipment (latrines, water source, cooking fuel, garbage disposal) are also examined against that SES index, to see whether access to those facilities is related to the wealth of the household. Table 6.13. presents the results of those analyses.

Table 6.13: Association between HH Wealth Index and socio-economic variables:

	Global Average	Wealth Tercile		
		Lowest	Middle	Highest
Demographic variables				
% with female heads[a]	15.1%	31.8%	10.1%	3.7%
Mean family size[b]	3.9	3.1	3.9	4.8
Mean education level of HHH [c]	4.2	3.0	4.5	5.2
Mean age of HHH[d]	47.1	46.4	46.5	48.2
Economic Variables				
Severity of coping strategies index[f]	4.26	4.41	4.40	3.99
Index of liquid assets [g]	207.3	156.1	198.8	266.5
Size of active labor force [h]	2.3	1.8	2.3	2.6
% with access to latrines or WC *i*	12.4%	10.3%	12.2%	14.7%
% w/access to protected water [j]	3.5%	3.2%	3.3%	4.0%
% w/appropriate garbage removal [k]	6.4%	5.6%	5.9%	7.7%

[a]Chisquare=518.523, p<.000; [b]f=319.863,p<.000; [c]f=33.938, p<.000;
[d]f=6.308, p<.002; [e]f=423.979, p<.000; [f]f=11.288, p<.000;[g]f=15.089, p<.000; [h]f=216.077, p<.000; [i]f=6.308, p<.002; [j]f=6.308, p<.002;k[j] Chisquare=7.03, p<.03

The results presented in Table 6.13 above provide some interesting findings: first, women headed households are significantly more likely to be poor than to be wealthy. Although not surprising, this finding has important programmatic implications, which we will examine later. Second, mean family size is positively and significantly associated with wealth, which supports the hypothesis that access to labor is critical in asserting the wealth of the family—a finding also corroborated when looking at the size of the active labor force. The age of the household head is also significantly associated with wealth, with older households being wealthier overall than younger ones (although we note that the variation in age years is very slight). That significant relationship may be related to the household's access to labor, which could be seen as evidence to substantiate the standard Chayanovian demographic cycle hypothesis[20]. With regards to the economic variables, it is no surprise to find that the index of liquid assets is positively associated with wealth. In all those aspects, therefore, the wealth indicator behaves very close to our

[20] Chayanov's theory suggests that wealth is not fixed but varies through the demographic cycle of the household. Younger units that are just getting started have low access to labor and little accumulation. As the children get older and begin to provide labor, the unit is able to bring in more land and to produce more, thus becoming wealthier. At the later stage of the cycle, children leave the unit to form their own families; then the household head releases land, and the unit becomes poorer again. If this theory were true, then the wealthier households would be found in the middle stage of the demographic cycle, i.e. those households whose head is of middle age. This appears to be the case here. Obviously the Chayanov hypothesis depends on the type of tenure system in place: for it to work, the land market must be free and unconstrained, a situation that is probably not entirely true for Ethiopia.

expectations, increasing our confidence that we can use this constructed index as a valid and reliable pointer to household wealth.

The results presented in Table 6.13 in relation to household utilities are similarly interesting. One opinion often heard in development circles is that access to amenities such as clean water, latrines, and electricity is not a function of wealth as such, but of the presence of a service provider in the environment. Said otherwise, the main determinant of access to those services is located at the community level, not at the household level. The data presented here clearly does not support that hypothesis. The differences in access to utilities are very large as one moves from one wealth tercile to the other: for instance, the wealthier the household the more likely it is to have a latrine or WC, to have access to a protected water source; and to use proper garbage disposal practices (although in this last case, the reason is probably not the capacity to pay since it costs nothing to burn or bury one's garbages—more likely, this finding is confounded by education, and the knowledge by the household members that sanitation is an important dimension of environmental and public health).

In conclusion to this chapter, we found that most people in our sample live in nuclear families, with a mean household size of 5.5 persons. About 18% of households are headed by females. Those female headed households tend to be smaller, poorer and the female heads are on average less educated than male heads. The main occupations of household heads revolve largely around agriculture, with only a reduced proportion declaring other sources of income such as trade, wage work or handicraft. When looking at conditions of living we find large variations between regions but little within regions as to type of home, sanitation facilities, and access to water. Most everywhere, distance to water increases dramatically during the dry season. Quantities consumed are well below international guidelines, making potable water an issue of paramount importance for development organizations in the sampled areas.

Most households also have problems in accessing food: overall, only 12.5% of households said they had enough food to cover their needs last year. Some of our data suggests this may be due in part to the drought that affected Ethiopia during the 2002-2003 period, which appears to have cut production by as much as a half, if not more. This should not detract from the fact that food insecurity is a chronic situation in Ethiopia: the drought certainly exacerbated the problem, but food insecurity is a condition that very many households confront regularly, year after year. The seasonality of hunger varies by region, with the months of low food supply corresponding to the summer months (April to September) in the agricultural highlands; and conversely from October to March in the pastoralist, semi arid regions of the South.

The coping strategies used by households when confronted to such hardships can be classified in three general categories: the mildest form corresponds to what we call "tightening the belt". 37% of households classified in this category. Next, households begin to "reach out" by either seeking income opportunities outside their usual occupations, borrowing from each other and the like. 44% of households were found to use this type of strategy. Finally, households that are most hard pressed resort to "divesting", i.e. selling their assets, consuming the seeds they had preserved for next year's planting, etc. 19% of households were found to use "Divestment" strategies. Not a single household was found that did not have to use one or the other of the main coping strategies.

Chapter Seven. Economic Activities of Households

In this chapter, we examine the strategies used by households in our sample to ensure their livelihood. As suggested by earlier Chapters, there is much diversity in the cultural and environmental context across the sample, which translates into highly varied subsistence arrangements. In this Chapter: we look at the main occupations across the sample. Note that, since crop agriculture is examined in detail in Chapters 8-10, this Chapter spends more time describing other common income generating activities, including livestock rearing, home industries and wage labor.

The most important occupations among people that are 6 years and above (but excluding those that go to school) are crop agriculture, unpaid domestic work, and herding (those include primary and secondary occupations). Examining more specifically the occupations among males versus females heads, crop agriculture is again mentioned by the majority of male heads (92.2%), followed by other paid work (21.5%). Females (whether the spouse of the male head, or the household head herself) show a slightly more diversified set of occupations besides unpaid domestic work, including crop agriculture, other upaid work and paid work (handicrafts, trade wages, etc). Few females list herding as a main occupation. This occupational structure is fairly homogenous across CSs, although some differences are evidenced, the most notable being the more frequent mention of herding by males in the SC/US area, and the relatively low importance of "other paid work" in the SC/US area.

Table 7.1. Proportion of population declaring main or secondary type of occupation (%)*

		CARE	CRS	REST	SC/US	WVI	Total
Cultivates own land	All (except students)	44.2	39.5	61.0	29.6	49.5	43.7
	Male heads	98.3	97.9	98.4	79.6	87.9	92.2
	Female head/spouse	17.9	12.4	55.0	11.9	44.5	27.0
Herder	All (except students)	19.6	13.8	15.8	36.9	20.4	22.1
	Male heads	1.6	2.7	1.1	30.6	11.2	9.8
	Female head/spouse	1.7	1.6	.4	13.6	1.6	4.0
Unpaid domestic work	All (except students)	41.1	53.9	20.6	46.0	36.0	40.3
	Male heads	.8	11.4	.6	13.8	.2	5.5
	Female head/spouse	90.3	95.8	42.5	85.7	69.5	78.2
Other unpaid work	All (except students)	1.3	16.0	11.5	15.6	5.1	9.9
	Male heads	1.5	6.1	6.7	9.3	2.4	5.2
	Female head/spouse	.7	21.3	19.2	21.2	8.6	14.1
Other paid work (handicrafts, trade, wages…)	All (except students)	9.6	13.9	23.1	5.4	14.3	12.6
	Male heads	13.9	21.6	43.8	9.1	22.7	21.5
	Female head/spouse	11.8	13.5	16.2	7.1	10.5	11.6

* Total is more than 100% as multiple responses were allowed

Livestock Rearing

Livestock is important everywhere in Ethiopia where economic arrangements used by households go all the way from mixed farming[21] in which cropping dominates, to pastoralist livelihood systems where animals provide households with most of their income and food in the form of meat, dairy products and blood. This varying importance of livestock generally follows well-defined cultural and agro-ecological lines, as livestock are well suited to low-populated, arid and semi-arid lowlands where they can offer relatively good economic returns. In our sample, the Boran pastoralists that live in the South of the country derive their living principally from pastoralism, and as a consequence their livelihood arrangements are distinct from those of communities living in the central highlands of the country. Table 7.2. begins our examination of those differences by presenting the type and mean number of animals owned by households across the five CS areas[22]. This shows that the majority of households in all regions keep a variety of animals: four out of every five family for instance have oxen, milk cows and calves. Likewise small ruminants are very frequent: more than 76% of households own goats; and almost 70% own sheep. Pack animals are also commonly owned, with 75% of units owning at least one donkey. Even bee keeping is relatively common with 42% of households owning one beehive or more. Thus on the aggregate, ownership of animals—of several animals of different kinds—is common. There are, however, differences between regions in the percentage of households that own each type. For instance, in Tigray and Liben and Filtu areas (REST and SC/US zones) bulls are owned by about 85% of households; whereas only 32% of units in CARE and WVE regions have such animals. Such contrasts are also notable with regards to camels, sheep and pack animals.

Table 7.2. Ownership of livestock assets: % of HHs that own and mean number of animals owned among HHs that own this animal

		CARE	CRS	REST	SC/US	WVE	Total
Oxen	% owning	69.1	79.6	93.8	85.3	82.3	82.2
	Mean n owned	1.31	1.46	1.51	1.95	1.44	1.51
Bull	% owning	32.8	66.0	84.6	84.5	31.2	55.9
	Mean n owned	1.11	1.14	1.28	1.84	1.28	1.42
Milk cow	% owning	70.3	83.6	81.6	99.1	70.9	81.4
	Mean n owned	1.14	1.47	1.27	3.05	1.29	1,82
Other cow	% owning	38.2	76.0	80.1	92.5	37.0	63.0
	Mean n owned	1.18	1.41	1.21	3.43	1.28	2.07
Heifer	% owning	50.7	77.5	77.0	92.6	43.5	64.9
	Mean n owned	1.16	1.47	1.19	2.53	1.22	1.63
Calve	% owning	66.0	80.5	87.1	98.3	68.6	79.3
	Mean n owned	1.27	1.49	1.35	2.66	1.40	1.77
Sheep	% owning	62.5	79.4	57.5	86.4	62.6	69.4
	Mean n owned	3.61	3.69	5.11	8.33	4.64	4.86

[21] By mixed farming we refer to a system where both cropping and livestock rearing are practiced in complementary ways, animals providing draught power, manure for fertilization and food; and crops providing animal feed as well as sources of food and income for humans.

[22] This is the same table that was presented in Chapter 6 when computing household asset indices

Table 7.2. Ownership of livestock assets: % of HHs that own and mean number of animals owned among HHs that own this animal

		CARE	CRS	REST	SC/US	WVE	Total
Goat	% owning	51.2	86.4	82.8	98.2	51.1	76.3
	Mean n owned	2.18	4.08	5.26	9.41	4.16	6.13
Donkey	% owning	59.2	83.0	87.0	90.1	66.7	75.7
	Mean n owned	1.21	1.46	1.61	1.53	1.36	1.44
Mule	% owning	6.0	19.4	16.0	28.0	11.89	11.3
	Mean n owned	1	1.14	1.88	1.0	1.04	1.16
Horse	% owning	36.1	6.9	10.4	13.6	12.2	22.7
	Mean n owned	1.23	1.0	1.80	1.67	1.33	1.28
Lactating camel	% owning	0.0	20.0	6.5	92.8	0.0	35.0
	Mean n owned	0	1.71	4.67	2.91	0	2.9
Other camel	% owning	1.6	43.8	21.1	94.6	2.60	38.1
	Mean n owned	1.33	1.81	1.33	4.69	4.6	4.30
Chicken	% owning	65.5	87.0	90.6	92.3	84.0	83.6
	Mean n owned	2.89	5.47	4.66	4.44	3.39	4.29
Beehives	% owning	15.3	72.0	72.2	84.7	23.1	42.0
	Mean n owned	1.39	2.22	1.79	7.02	2.09	2.72
Mean livestock asset index*		1579.83	2018.00	1894.75	6991.90	1856.78	2889.91

*The livestock asset index is a sum of the number of each animal owned by each household at the time of the survey multiplied by the unit value of this animal. The unit value per animal was obtained from the EU's price monitoring unit, which maintains monthly statistics on the price of most agricultural products in various regions in the country.

The greatest difference, however, lies in the size of the herd. Households in the SC/US area have larger numbers of cattle, small ruminants, camels and beehives than households in any of the other areas considered here. This is usefully summarized by the mean livestock asset index value, computed by using the number of each animal owned by a household multiplied by the unit value of this animal, and then aggregating those values across all animal types owned by the farm. According to this index, the value of animals owned by pastoralist households in the Liben/Filtu area is two to three times higher than among households in any other area.

Given the importance of animals in the farming economy, it is interesting to observe herd dynamics through the year. Table 7.5 shows that important changes occurred in the 2002-2003 year, with the final result being a net reduction in overall numbers of animals owned. From a mean value of 2890 EB at the beginning of the 2002-2003 agricultural year, the mean value of livestock owned had fallen to 2485 EB by the end of the year. This represents a negative change of 14 percent in total livestock capitalization, a reduction mainly attributable to the death of animals because of disease and lack of water. As is clear from Table 7.5., not all areas were hit equally hard. The SC/US area, where cattle is most important, was less affected by the drought than the CARE and CRS areas where farms lost on average a quarter of their animal assets[23].

[23] Even them were less affected that other regions: for instance more than 75% of the cattle in some districts of the Afar region died during this drought.

Table 7.3. Livestock assets (EB) at beginning and end of 2002-2003 agricultural year						
	CARE	CRS	REST	SC/US	WVE	Total
Value at beginning of year	1579.83	2018.00	1894.75	6991.90	1856.78	2889.91
Value at end of year	1168.68	1516.09	1739.96	6317.34	1586.95	2484.86
Percentage difference	-26.02	-24.87	-8.17	-9.65	-14.53	-14.02

The importance of animals lies not only in their value as store of wealth but also in the by-products obtained from their upkeep, such as dairy products, meat, hides and skins, which can be consumed directly by the household or sold on the market. Animals also provide draught power for field cultivation, can be used to transport produce to markets, and provide manure that may be used as fertilizer and/or as combustible by households. It is difficult to represent the entire subsistence value of animals in terms of their overall contribution to the household economy, so we limit our review here to the contribution in terms of milk and meat to subsistence; and to the value of animal products sold on the market.

Beginning with milk, we evaluated the quantities likely obtained by aggregating the production from the various milking animals owned by the houhehold, taking into account factors such as: the type of animal, their average daily production, and the average number of lactating days per year[24]. The production across animals is aggregated after transforming the resulting quantities into their monetary equivalent, assuming a value of 2EB per liter of milk (median value declared by farmers, all animals). Results show the importance of milk production to farming households in Ethiopia, particularly in the SC/US area where total milk yield is nine to ten times that obtained in other areas.

Table 7.4. Mean value of animal by-products available for consumption to household						
	CARE	CRS	REST	SC/US	WVE	Total
Milk (EB equivalent)	287.73	404.97	276.51	3560.10	314.32	968.54
Meat (EB equivalent)	22.37	48.26	31.84	175.04	30.04	61.93
Kcal from animal sources	157,193	228,272	206,770	1,504,865	196,213	517,384

With regards to meat, we assumed that animals slaughtered were consumed by the household[25]. An average cattle weight of 230kg (Stuth et al, 2003) was assumed, with a meat yield of between 38% and 50% of total live weight (FAO) yielding between 87.4kg and 115kg of edible meat per cattle head slaughtered (we thus used 100kg as mean value). Similar calculations assumed a meat yield of 10kg per head for sheep and goats; and .5kg per chicken. Aggregating those quantities across animal types provides a proxy for the amount (in kg) of meat produced per household for subsistence. This weight was then converted into monetary value assuming a price of 10EB per kg of meat (all animal meats being given the same value). Results suggests that the value of meat production is very reduced, if one accepts our proxy. Here again, households in the SC/US area appear to be the largest consumer of meat overall.

[24] To compute milk production from goats, we assumed that a goat produces on average .27l of milk/day. The duration of lactation is 184 days on avge, which means .136l/day through the year. A quarter of the goat herd are lactating adult females so a herd of 10 goats produces 124.1 l of milk/year ((.136x365/4)10). A lactating cow produces .65l/day. A lactating camel produces 4.2l/day (Ba Diao et al, 1994).

[25] This is rational since animals sold are accounted for separately. Possibly, households may sell meat but very few households do so (1.8% overall; see next Table) thus this possibility is negligible.

The last transformation consisted in attributing a KiloCalorie value to milk and meat, in order to assess the contribution of animal-source foods to the overall diet. The kcal content in milk varies by animal type, so the appropriate coefficients had to be applied to those calculations[26]. The results show that in our sample, enough animal source foods was produced on average to sustain 246 days of adult equivalent needs (estimated at 2100kcal/day/person) per household. We still have to compute the number of adult equivalent persons per household to see how animal source foods contribute to total family intake—this is done in Chapter Eight, where the total Kcal obtained from crops is added to Kcals obtained from animal source foods, and then compared to the total number of household members to provide an estimate of the capacity of households to meet their dietary requirements from their own production[27] (see Table 8.6 below).

The final contribution from animals we examine is market sales. Our data suggests that only dairy products (milk and/or butter), and eggs are sold on a more or less regular basis. All other activities are very reduced (meat is sold by 1.8% of househods; skins and hides, 2.9%, wool, .4%; other products, 2.4%). Milk represents an important source of revenue for almost a quarter (23.5%) of all households, however; whereas close to 17% of units sell eggs. The mean value of sales is reduced in all cases, however (except for milk, which yields slightly more than 500EB on average to those who sell it). Table 7.5 presents data on the mean value of various animal products sold by households.

Table 7.5 Mean value of animal by-products sold by area

		CARE	CRS	REST	SC/US	WVE	Total
Meat	% selling	.7	.7%	4.2%	2.8%	.4	1.8%
	Mean value of sales	186.14	508.28	107.39	870.04	419.5	401.79
Dairy	% selling	21.3%	17.0%	21.7%	38.4%	14.5%	23.5%
	Mean value of sales	514.39	458.38	271.41	784.84	112.07	518.77
Eggs	% selling	12.6%	23.1%	17.0%	3.0%	23.5%	16.7%
	Mean value of sales	53.16	157.33	110.01	263.32	170.96	138.99
Skins/	% selling	2.6%	6.5%	1.4%	.6	3.0	2.9%
Hides	Mean value of sales	46.63	56.9	133.76	68.17	175.27	89.77
Wool	% selling	0.0	.1%	.1%	0.0	0.0	.4%
	Mean value of sales	0	60.0	45.00	0	0	42.40
Other	% selling	.4%	3.8%	4.3%	.5	2.2	2.4%
	Mean value of sales	50.50	207.74	134.49	51.2	194.37	164.67

Home Based IGAs

Our review of household strategies now takes us to a set of home-based income generating activities that are used by household members in various degrees across sites. We classify those into three main groups, namely: farm by-products; small home industries; and wage labor occupations. In turn each of them contain the following sub-categories:

[26] Cow milk contains 650kcal per liter; sheep, 1080; goat, 710; camel, 650 (Ketema and Tsehay, 2000; SC/UK, 2000).

[27] As a first approximation, if we assume 5.5 adult equivalents per household, then animal-source foods provide the average household with enough to eat for 44.7 days. This would be much higher (about three times more) in the SC/US area, where animals provide 130.3 days of food to the average household.

- Farm by-products: includes beehives, poultry, fodder grasses, home gardens, vegetable and fruit production, and forestry products
- Small home industries: includes handicrafts, trade, value added transformation
- Wage labor: includes local or migrant work in both agriculture or industry

Of those three groups, farm by-products occupy the largest niche, representing 35% of all activities; followed closely by wage employment (31% of activities); home industries (15%); and others (19%) (Table 7.2.). The relative importance of those categories can vary by CS: farm by-products although mentioned in all sites, are most frequently produced in CRS, REST and CARE areas (with poultry raising an important component in all three cases[28]). Home industries are mentioned most often in SC/US sites (particularly handicrafts and value added transformation) and in WV areas (mostly petty trading and handicrafts). Wage labor is mentioned in CRS and to a lesser extent in CARE areas (in local agriculture); as well as in the REST area (in local industry). Wage occupations are virtually absent from the area covered by SC/US, however, where other unclassified occupations seem to provide alternative options to households in the SC/US area.

Table 7.6. Relative importance of alternate income generating activities (% of total instances mentioned)

	CARE	CRS	REST	SC/US	WV	All
Farm sale of by-products	**34.6**	**34.2**	**38.6**	**18.4**	**31**	**35.2**
- Honey	1.4	1.4	6.1	6.7	1.2	3.4
- Poultry	17.9	12.4	24.6	7.5	21.0	18.4
- Fodder grasses	.3	--	.4	--	--	.2
- Backyard/home gardens produce	.2	.2	.3	--	.2	.2
- Vegetable produce	1.5	.8	3.0	1.7	1.2	1.8
- Fruit produce	2.9	.1	.8	.8	--	1.0
- Forestry products	9.9	15.5	3.0	1.7	6.9	8.9
- Multi-purpose trees	.5	3.8	.4	--	.5	1.3
Home industries	**18.6**	**6.8**	**7.3**	**42.1**	**42.2**	**15.2**
- Petty trading, market sales	17.0	5.5	5.2	--	10.4	9.8
- Handicrafts	1.4	1.3	2.1	27.5	22.2	4.1
- Value added transformation	.2	--	--	14.6	9.6	1.3
Wage labor	**25.6**	**45.5**	**35.6**	**4.5**	**12.1**	**31.1**
- Wage labor in local agriculture	13.1	38.9	7.5	.8	7.4	16.3
- Migrant wage labor in agriculture	5.6	1.9	2.5	.4	.7	2.5
- Wage labor in local industry	2.3	3.3	15.2	.4	.5	6.7
- Migrant wage labor in industry	--	.6	2.2	--	.5	1.0
- Daily labourer	4.6	.7	8.2	2.9	3.0	4.5
Other	**21.3**	**13.8**	**18.7**	**36.0**	**14.5**	**18.6**

[28] Note that poultry raising is considered separately here from the previous analysis of livestock assets. This is because the data on poultry presented in Table 7.6 refers to this activity conducted as a business, whereas the previous analysis considered chicken as part of household livestock assets. The two pieces of information were collected separately by the survey questionnaire.

Conclusions

Although most households rely on agriculture to compose their livelihoods, there is some amount of diversification in the peasant economy, as attested by the various income generating activities found in our sample. The relative economic importance of those alternative sources is reduced, however. Important differences were noted between regions, in particular with respect to the use of wage earning opportunities and the practice of trading, handicrafts and other home-based industries. The critical importance of herding was also demonstrated in this Chapter, an issue that will be further elaborated in Chapter Eight on agriculture.

PART III

SURVEY RESULTS: AGRICULTURE

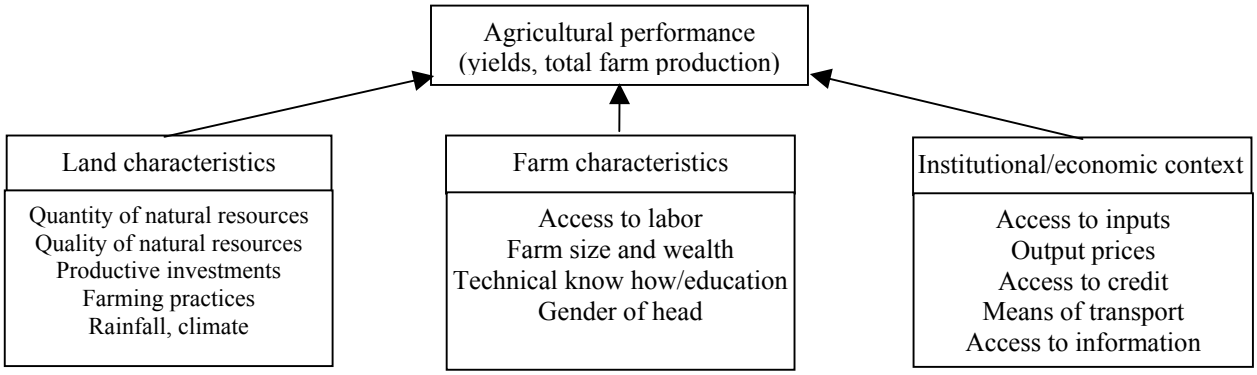
Chapter Eight: Household Agricultural Performance

The main goal for most agricultural interventions is to increase the performance of farming by improving levels of crop output. The best indicator to state whether this result was obtained depends on the precise aim of the program. If farming efficiency is pursued, such as increasing the volume of production per area planted, then an indicator such as yields per crop is appropriate. If the aim is to improve household food security, the success of the intervention can also be stated as an increase in total farm production which, once converted into a common yardstick such as monetary value or kilocalories, links the nutritional and economic needs of a farming household to its agricultural output.

Programs that aim at increasing agricultural performance typically target the factors that influence farm output. There is no "off the shelf" conceptual model laying out the factors accounting for the performance of farming in developing countries, so the survey team designed its own model (Figure 8.1.) by making agricultural performance a function of three broad categories of factors, namely: 1) land characteristics; 2) farm characteristics; and 3) institutional and economic context. In turn:

4) Land characteristics are defined as a function of the quality and quantity of the land available to the producer, the productive investments made and farming practices used on that land, and exogenous factors related to the agroecology.
5) Farm characteristics include household wealth and access to family labor, farm size, technical knowledge and education of the farmer, and gender of the household head
6) The institutional/economic context, finally, refers to the input and output markets, access to productive capital, means of transport and access to information.

Figure 8.1.: Conceptual model of determinants of agricultural performance



This Section uses this model to review the outcomes of agricultural programs in Ethiopia and at the factors determining those outcomes. Chapter Eight focuses on indicators of agricultural performance, Chapter Nine looks at the determinants of that performance and Chapter Ten proposes a multivariate analysis of those factors, to disentangle which factors most affect agricultural output in the three regions investigated. Those findings should help the CSs design interventions that use most effective levers to induce change in agricultural practices.

We begin our discussion of those issues in Chapter Eight with the examination of the two main outcomes of CS agricultural programs (yields and total farm production), starting with a discussion of how to interpret those indicators.

Yields, first, are function of the total quantity of output per crop per surface area. Yields measure the efficiency of farming. Achieving higher yields usually requires that the producer intensifies his use of the land. This may be done by increasing the use of agricultural inputs (e.g. fertilizers, improved seeds) and/or by changing cultural practices (e.g. increasing planting density). Improving farmers' access to inputs and use of better practices are typical focus of agricultural extension services, and yields are a good indicator of success for such programs. However, yields may not suffice to indicate success in food security terms, as they say nothing about the amount of land over which the increase is obtained. Clearly, being more efficient helps in producing more but if the land available to the farmer is very small, it does not matter in the end by how much yields are increased since it may not be enough to satisfy household food needs.

The indicator we call "Total farm production" nicely complements yields in this regard as it measures, not how efficient a farmer is but how much is produced overall on the farm—and hence, how much is theoretically available for the family to consume. There are two main limitations to this indicator, however. First is the problem of attribution: it is not clear why increased farm output is achieved in the first place, as the increase may also be due to extensification (i.e. expansion of the total surface area under cultivation). Second, all crop quantities must be translated into a common measure before they are combined and summed up. The three common yardsticks used to do so (kilocalories (kcal), monetary value (cash) and number of months of food reserve), have different properties, none of which provides a fully satisfactory solution to the discussion of food security. In our text, we use these various formulations in the form that is most appropriate given the context.

Crops Produced

Farmers in Ethiopia grow a large variety of crops. In our survey, twenty eight different crops were mentioned by the producers interviewed. However, as shown by Table 8.1., many of those are not frequently cultivated. Crops that are grown everywhere with large frequency are essentially the key basic grains. Barley, wheat and maize are the ones most frequently mentioned by farmers, being found in 40.8%, 40.1% and 39.3% of all farms respectively. Teff is also found with good frequency, being mentinoed by about one third of all farmers (31.3%). Beans (23.1%) and sorghum (17.7%) are more locally specific. After those, the frequency of crop planting diminishes rapidly. The other food crops mentioned seem very site-specific—potato, for instance, is given importance only in the CARE area; while *enset* is mentioned only in the WV area. Chat, a cash crop, is also specific to the area covered by CARE.

Table 8.1. Percent of farms that cultivate each crop[29]						
Crop	**CARE**	**CRS**	**REST**	**SC/US**	**WV**	**% HH growing**
Maize	47.9	45.7	23.0	65.5	14.3	39.3
Wheat	28.1	44.8	65.0	13.1	50.1	40.1
Sorghum	35.2	23.9	18.6	4.9	5.5	17.7
Teff	6.6	16.4	74.8	16.5	43.4	31.3
Barley	37.7	38.9	63.6	9.1	54.9	40.8
Beans	26.6	9.8	31.7	19.6	30.3	23.6
Lentils	4.8	2.1	6.7	0.4	8.0	4.4
Other grain-pulse	23.1	14.0	6.2	0.6	1.5	9.1
Enset	0.5	--	0.1	--	18.2	3.7
Plantain	--	--	0.1	--	--	0.0
Cassava	--	0.1	0.2	--	0.3	0.1
Yam	0.1	--	--	0.1	--	0.0
Sweet potato	3.4	0.4	--	--	--	0.8
Tomato	--	--	0.1	0.1	0.4	0.1
Onion	3.9	--	4.7	--	0.2	1.8
Carrot	--	--	0.2	--	0.6	0.2
Beet	--	--	0.1	--	0.1	0.0
Swiss chard	0.1	--	0.9	--	--	0.2
Potato	27.0	1.4	0.7	--	4.2	6.8
Peanut	0.3	--	0.4	1.5	--	0.5
Green bean	0.3	--	--	--	--	0.1
Coffee	3.2	0.3	0.1	--	0.1	0.8
Chat	25.4	3.6	0.1	--	--	5.9
Banana	0.1	--	0.3	0.2	--	0.1
Papaya	0.5	--	0.1	0.1	--	0.2
Mango	--	--	0.1	--	--	0
Other crops	30.2	1.0	18.5	2.6	27.4	16.0

Our next Table presents the yield data by crop, concentrating essentially on the six main food crops grown as pure stands[30]. The data in Table 8.2. suggests large variations in yield performance by region for each of the crops considered. Again, this is not surprising given the differences that exist at the level of local agroecologies. What is more worrisome is the very low level of yields recorded in each crop, when compared to the yields that might be expected under ideal production conditions (e.g. an agricultural research station).

[29] Several concerns should be mentioned on Table 8.1. (i) Millet, a fairly widespread crop in the Highlands, is not be reported here (it was coded under "Other crops" by enumerators); (ii) The low figure for chat in the CRS area is dubious. Perhaps farmers were reluctant to admit cultivating it; (iii) the SC/US figures showing the importance of wheat and teff contradict the common belief that farmers in this area are increasingly turning to opportunistic of short cycle crops because of increasing moisture stress.

[30] Farmers in Ethiopia most generally grow their crops in pure stands, although they may also grow their crops in association. Because of the difficulty of deriving yields when crops are grown in association, we present only the yields for the crops grown in pure stand, concentrating on the six main grain crops.

Table 8.2. Yield of crops in quintals (pure stand only) (quintals per hectare)						
Crop	**CARE**	**CRS**	**REST**	**SC/US**	**WV**	**Average**
Maize	13.49	11.62	7.16	11.29	5.88	10.84
Wheat	11.21	10.42	9.02	8.59	5.94	8.80
Sorghum	7.86	4.48	6.74	6.75	6.39	6.60
Teff	6.72	5.12	7.31	4.85	7.22	6.72
Barley	7.90	8.99	7.37	6.68	4.82	7.03
Beans	8.75	5.78	5.74	6.07	7.00	6.75
Lentils	1.41	5.36	3.44	3.02	4.59	3.63

Looking at yields of crops grown in pure stands (Table 8.4a.), we see that maize reached 10.84qq/ha in our sample; yields for wheat were 8.80qq/ha, sorghum reached 6.60qq/ha, teff 6.72qq/ha; barley 7.03qq/ha; beans 6.75qq/ha and lentils, 3.6qq/ha. All those yields are very low when compared to their theoretical potential (defined as yields of the same crop when grown in an agricultural station)[31]: maize for instance theoretically produces between three and a half to seven tons per hectare in an agricultural station (depending on the variety: the Hararghe 1685 can reach 70qq/ha). It reached only 31% of the more conservative figure of 35qq/ha in our sample. All crops considered here show similar or lower ratios: farmers who grow crops in pure stand obtain between 20% and 36% of the yields obtained in experimental stations (always comparing to conservative estimates of station data). There is thus ample room for increasing yields on all major grain crops. Reducing this gap is certainly a pressing priority for the CSs.

Table 8.3. Current versus potential yields (all in pure stands, quintals per hectare)			
	Current yield	Potential yield in experimental station	Yield gap ratio (Current / Potential)
Maize	10.84	35	.309
Wheat	8.80	45	.196
Sorghum	6.60	30	.220
Teff	6.72	20	.336
Barley	7.03	20	.352
Beans	6.75	20	.338
Lentils	3.63	10	.363

Total Farm Production

Total farm production is a useful indicator of household food security because it says how much is theoretically available for a household to consume from its own production. This can later be converted into kilocalories (kcal), to assess how much of the daily household kcal requirements are satisfied by its own production. It can also be converted into cash equivalent, to account for crops that are not eaten or have low caloric density, but are important for income generation. We examine those various issues in the following paragraphs.

[31] Data from Ethiopian Seed Enterprise, Crop Varieties Bulletin, June 2001. Note that we purportedly chose the improved varieties that had the lowest yield. This explains why, for instance, maize's potential yields in Table 8.3 are only 35qq/ha—it may be much higher but we chose the most conservative estimate.

The data on quantities produced of each crop shows that the main crop is maize (3.42 quintals produced per farm on average), followed by sorghum (2.18 quintals), teff (1.78 quintals) and wheat (1.65 quintals). There are important variations in the importance of each crop by CS area. Looking at maize for instance, farmers in the CARE area obtained 2.49 quintals during last year; while farmers in the SC/US area harvested more than twice that amount (5.27 quintals). The data also shows the dominant crop in each area. Farmers in the CRS area for instance seem mainly bent on producing maize, teff and other grains; whereas farmers in the REST area are mostly involved in the production of lentils and other (unspecified) grains or pulses. Farmers in the other three areas cultivate a mix of crops, with no one distinctly emerging as dominant.

Table 8.4. Total production of crop by CS area in quintals[32]

Crop	CARE	CRS	REST	SC/US	WV	Average
Maize	2.49	3.04	1.50	5.27	2.13	3.42
Wheat	1.84	1.58	1.44	3.43	1.33	1.65
Sorghum	3.11	1.63	1.27	1.89	1.49	2.18
Teff	1.12	2.63	1.69	1.67	1.80	1.78
Barley	1.60	1.24	1.43	1.83	1.45	1.45
Beans	1.38	.66	1.63	2.31	1.40	1.54
Lentils	.16	.53	2.72	1.27	1.23	1.38
Other grain-pulse	.98	2.18	2.05	1.81	.79	1.52

The total quantities produced when considered at the farm level are relatively small. If we consider only households that engage in the production of those crops, farmers in our sample produced on average 3.42 quintals of maize, 1.65 quintals of wheat, 2.18 quintals of sorghum, 1.78 quintals of teff, 1.45 quintals of barley, 1.54 quintals of beans and 1.38 quintals of lentils (obviously, those averages being computed across all producing units we do not imply that all households produce such amounts of each crop. The amount of food available to a household must instead be computed separately for each farm taking into account its specific crop mix).

It is useful for comparison purposes to transform those quantities using a common conversion factor, in order to reduce all values to a single denominator. The first factor we use here to convert all crops into compatible units that can be later aggregated at the farm level is the kilocalories (kcal)[33]. The FAO provides useful reference tables specifying kcal equivalences for each crop considered here[34]. The values presented in Table 8.5. allows us to compute the total kilocalories produced by each farm.

[32] This data refers to both the Meher and Belg season production, and does not distinguish between a crop that is cultivated in pure stand versus in association

[33] Kilocalories is useful as a summary indicator as it represents energy, i.e. the bulk of the diet. It says nothing, however, about the quality of the diet, i.e. its protein or micronutrient content, which limits its use.

[34] USDA National Nutrient Database for Standard Reference, Release 15

Table 8.5. FAO kilocaloric equivalence for 1 kg for crops of reference			
Crop	**Kcal per Kg**	**Crop**	**Kcal per Kg**
Maize	3650	Sweet potato	2000
Wheat	2860	Tomato	210
Sorghum	3390	Onion	400
Teff	3670	Carrot	500
Barley	3610	Beet	500
Beans	3410	Swiss chard	500
Lentils	3450	Potato	820
Other grain-pulse	3410	Peanut	5670
Enset	2000	Green bean	500
Plantain	1500	Banana	880
Cassava	1120	Papaya	320
Yam	1120	Other crops	3650

To assess the degree to which production is sufficient to supply the household with its needs in kcal, we must also take into account the individual needs of each individual in the household, then sum up those individual needs to arrive at total daily household requirements. That quantity can then be compared to the amount of kcal produced by the farm, to provide an approximate measure of the extent to which farming households surveyed are able to supply the kcal needs of their various members from their own production. Using this approach we summed up the total daily and yearly kcal needs per household[35], computed the total kcal produced by the farm (note that this includes animal source products, derived from Chapter 7), and computed the ratio between the two to provide a measure of the kcal RDA that are theoretically satisfied by the household's own production. Table 8.7. presents summary statistics that illustrate the situation in our sample in this regard.

Table 8.6.: Proportion of KCAL RDA satisfied by own production						
	CARE	CRS	REST	SC/US	WV	Average
Mean	36.88%	33.46%	25.14%	62.21%	26.91%	36.80%
25th Percentile	13.72%	8.86%	8.25%	20.61%	9.93%	11.15%
50th Percentile	27.85%	16.85%	18.16%	43.43%	19.72%	23.48%
75th Percentile	50.07%	33.57%	33.32%	80.76%	37.17%	45.86%
At least 100% of needs satisfied	5.5%	7.5%	1.6%	18.2%	1.6%	5.5%

It appears from those calculations that the overwhelming majority of households are unable to satisfy the kcal needs of their members throughout the year from what they produced during the agricultural year: on average, households in our sample produced only 37% of their yearly kilo-caloric needs. Half of all households produce only 23.5 percent of their needs and only 5.5%

[35] To do those computations, we used FAO's Human Energy Requirements projections, which specify the number of kilocalories needed by a person on a daily basis to lead a healthy and productive life, taking into account the age and gender of that person FAO's projection are described in James, W. P. T.: Human energy requirements : a manual for planners and nutritionists / Oxford ; New York, 1990.

could meet their full kcal requirements for the whole year from their own production. We are aware that this is not a complete picture—households may also access food by purchasing it. Knowing that cash availabilities are also low, however, those deficits appear staggering. Clearly households' dependence on food aid or other sources of food must be very high, since they can fulfill so little of their needs from their own production.

Conclusions and Recommendations

In summary, our review of agricultural indicators show that production performance in our sample is very low. Yields are less than a third of what they could be and very low levels of total production are shown across all farms. Such low levels of production, in turn, are a function of both poor yields and absolute land constraints. Together, those factors translate into insufficient quantities of food to sustain family members, and in a reduced potential for generating cash income from agriculture. We therefore conclude that the current efforts deployed by the CSs to improve both the productivity of farming and the total levels of production are important, but in CS intervention areas, ensuring household access to sufficient food will not be accomplished by focusing solely on agriculture. It will be necessary to consider alternative forms of income generation as well.

Chapter Nine: The Determinants of Agricultural Performance

The previous Chapter highlighted the situation of the average farm in Ethiopia. Its agricultural production is very low, so much so that only a very small minority of them is able to fulfill the nutritional needs of its members from own production. This low production capacity has to be understood in the context of the various determinants of agricultural performance in Ethiopia. In the following section, we look at the most important of those determinants, namely, the quality and quantity of land available to farmers, the farm level most salient features, and economic/institutional factors. This review will help identify opportunities for CSs to improve performance in agriculture. The conceptual framework presented in Figure 8.1. is used to structure the discussion.

Univariate Analyses of Determinants

Plot Characteristics

In this section we examine the quality of the land available to the farmer, its physical characteristics, how it is used, and the improvements made on it. We examine the quantity of land and size of farm in the section on farm characteristics.

The quality of the land is a function of characteristics such as soil quality, topography and access to irrigation, which all affect a plot's productive capacity. Soil quality is itself a function of a number of characteristics such as soil depth, soil type, nutrient content, organic matter content, porosity and the like. Those characteristics were not measured here, but farmers were asked to label their plots using indigenous categories[36] which were subsequently recoded into the three general classes of poor, medium and good soils[37]. The breakdown of this data shows that farmers divide their land into roughly equal proportions between the three classes, with a slight dominance of Good soils (except in the CARE area).

Table 9.1. Soil quality of the plot

	CARE	CRS	REST	SC/US	WV	Average
Poor	29.7	28.6	34.1	16.4	41.9	31.9
Medium	44.4	31.1	25.9	47.7	11.2	30.0
Good	25.8	39.1	40.0	35.3	46.9	37.8

Another element that may affect the productivity of the soil is the topography of the plot. Topography affects the depth of the soil as plots under steep slopes accumulate less soil than flat ones, particles being carried down by water runoff during the rains. The same process affects the fertility of the soil, as the fertile, nutrient-rich topsoil is the first to get carried away by water runoff. In addition, it is more difficult to plant on the slopes: access may be uneasy and often oxen cannot be used. In our sample of land parcels, sixty six percent of the plots are considered flat, twenty nine percent are under "gentle slope"; and the remainder (4.7 percent) are under a steep slope (Table 9.2.). Those proportions are more or less the same across regions, with

[36] Indigenous categories are *Welka, Ashewama, Bunnama, Delefama, Key Afer, Chewama, Tukor Bunama.*
[37] The transformation of this classification into poor, medium and good soil, is not exact as the indigenous categories represent soil types, not quality. Soil quality may be a poorly described by this recategorization.

perhaps a greater proportion being under some slope in the CARE and CRS areas. It therefore appears that farmers chose those plots that are easiest and most amenable to cultivation, which is normal.

Table 9.2. Topography of the plots by CS (% of plots in each class)

	CARE	CRS	REST	SC/US	WV	Average
Flat	51.7	55.7	72.7	76.8	71.9	65.6
Gentle slope (or mixed)	39.7	35.9	22.9	20.4	26.2	29.2
Steep slope	8.7	8.4	4.4	2.8	2.0	4.7

In Ethiopia, altitude is commonly used as a referent for agroecology and this affects production in several important ways: altitude affects the temperature and seasonality pattern, and thus the length of the productive season; and it may affect the amount of precipitation received by the crop. As such, the importance of agroecology is not so much in determining yields per se, but in determining what type of crops will be grown by the farmer. Our respondents were asked to classify their plots along the following agroecological categories: *Dega* (above 2,300m); *Woina Dega* (from 1,500 to 2,300m); *Kolla* (500-1,500m) and *Benha* (less than 500m). The resulting data shows important variations by CS, with CARE, REST and WV having the largest portion of their beneficiaries located in highland *Dega* zones; SC/US being largely in mid to lowland *Kolla*; and CRS and WV in *Woina Dega*. Only one percent of all plots are located in the lowand *Benha* almost all of them in the SC/US area.

Table 9.3. Agroecological zones by CS (% of plots in each class)

	CARE	CRS	REST	SC/US	WV	Average
Dega	44.8	19.5	45.9	.1	39.6	34.2
Woina Dega	41.2	32.7	20.4	.9	41.0	29.5
Kolla	13.5	47.5	33.0	88.3	18.6	34.5
Benha	.1	.1	.1	8.5	.1	1.1

Yet another element that explains land productivity is access to irrigation. Moisture stress, a frequent occurrence in several regions of Ethiopia, can have far reaching effects on plant growth and yield. Having the capacity to irrigate the crops helps mitigate the vagaries of the weather, and can considerably influence the outcome of cultivation. In our sample of farms, agriculture is predominantly rainfed. Less than one in every twenty plots (4.9 percent) is irrigated, and those that do generally use traditional irrigation systems. All the other plots (94.7 percent) have no irrigation facilities (Table 9.3). The situation in some of the CSs is even more extreme: only 1.2% of the plots in SC/US's beneficiary areas are irrigated. The crops growing on those plots thus thrive entirely on available rainfall. It is worth repeating here that the 2002-2003 agricultural year (over which the data was collected) was particularly hard on agricultural producers as a persistent and severe drought condition prevailed in most of the Northern, Eastern and Central regions. There is little doubt that this excessive climatic condition had a profoundly negative impat on agricultural productoin in many of our sampled areas.

Table 9.4. Irrigation of the plots (% of plots in each class)						
	CARE	**CRS**	**REST**	**SC/US**	**WV**	**Average**
Irrigated	10.7	2.6	4.9	1.2	2.9	4.9%
Non irrigated	89.3	97.4	95.1	98.8	97.0	94.7%

Social factors that determine access to land (we think particularly here of land tenure) can also affect agricultural outcomes, by influencing how the land is operated, as well as the investments a farmer is likely to make to improve the productivity of that plot. A common hypothesis here suggests that land which is owned by the farmer (or is under a secure form of tenure) is more likely to receive investments than land not owned, as the farmer may lose the benefit of the investment if access to that land can be disputed or denied. Investment in turn is expected to increase the productivity of the plot, first thanks to the improvements made, and second because the farmer will spend more labor and other resources in plots where he has already sunk capital. Thus we expect security of tenure to be positively associated with both the likelihood of putting a plot under cultivation, and with the proportion of the plot that is put under cultivation. Table 9.4. offers a preliminary breakdown of the data with regards to tenure[38]. The most common means of acquiring land is to have it allocated by the Peasant Association (61% of cases) or to inherit it (25%). Other forms of obtaining land such as rental, sharecropping, borrowing or exchanging it are much less common. This general pattern holds true when we disaggregate the data by CS, with a few differences appearing (for instance in the CARE and CRS areas, where gift seems more frequent). Markets for renting land, although timid everywhere, appear to be more active in the CARE area, and to a lesser degree, in the CRS and REST areas. The last two lines of the Table show a summarized classification of tenure, categorizing the mode of acquisition between "most secure" and "least secure"[39]. As can be seen from this, farmers' access to land is generally "secure". It should be noted however that we have no information on the titling of the land itself—this is a concept that is only now slowly beginnning to emerge in political and economic thinking in Ethiopia, and it was not included in this survey. One could argue for instance that the land allocated by the PA is not secure, as it can be taken away from the family to be redistributed to other households. Because current definitions are in flux, therefore, we will interpret the findings related to this variable with caution.

Table 9.5. Tenure of the plots (mode of acquisition) (% of plots under each type)						
	CARE	CRS	REST	SC/US	WVE	Average
Owned by inheritance	35.5%	30.3%	11.8%	28.3%	24.3%	25.1%
Owned by PA alloc.	41.3%	54.7%	73.2%	67.2%	68.5%	61.2%
Owned from gift	10.3%	9.2%	1.1%	1.3%	1.3%	4.6%
Rented in	6.3%	4.5%	3.8%	1.1%	3.2%	4.0%
Rented out	5.7%	.7%	1.6%	--	1.0%	2.0%
Sharecropped in	.4%	.1%	4.5%	.9%	.6%	1.5%

[38] This data does not truly refer to "tenure" but to how the land was acquired. This may matter: an untitled or inherited plot may be less safe if someone else has claims to that land.

[39] Most secure includes inheritance, PA allocation, owned from gift, rented out, sharecropped out, borrowed out and exchanged. Least secure include rented in, sharecropped in, borrowed in and gift out. It should be noted that this classification is debatable, especially considering recent policy changes on tenure. Also, we are surprised to see such low values associated with sharecropping as this is common in Ethiopia.

Table 9.5. Tenure of the plots (mode of acquisition) (% of plots under each type)						
	CARE	CRS	REST	SC/US	WVE	Average
Sharecropped out	.1%	.2%	3.8%	.1%	1.1%	1.3%
Borrowed in	.0%	.1%	--	.2%	.1%	.1%
Borrowed out	.1%	--	.1%	.3%	--	.1%
Gift out	.1%	.0%	--	.1%	--	.0%
Exchanged	.2%	.1%	.1%	.6%	--	.2%
Most secure	93.2	95.3	91.7	97.7	96.1	94.4
Least secure	6.8	4.7	8.3	2.3	3.9	5.6

We now turn briefly to how the land is used among farmers in our sample. The most common way of using land use in this sample is to crop (76%), or to use it for building the homestead (17%). Other types of use such as forest, pasture or unused land (all non-intensive) are rare, representing only about 6% between them. This suggests that land is used very actively in all areas, corroborating the results reported earlier in Chapter Five, and suggesting an intense pressure on the natural resource base. Such constrained acccess to land may mean that people cannot afford to leave it idle. Serious consequences may ensue, however, as constant cultivation depletes the land and makes it more prone to degrade, if no particular precautions are taken.

Table 9.6. Main forms of land use (% of plots in each type of use)						
	CARE	CRS	REST	SC/US	WVE	Average
Homestead	18.7	18.1	8.7	43.0	12.0	17.5
Cultivated	76.7	75.9	85.1	54.0	78.1	76.2
Pasture[40]	2.0	2.8	.4	.5	7.7	2.9
Fallow[41]	.7	.7	4.0	1.5	1.1	1.7
Wooded	.5	.1	1.7	.6	1.0	.9
Unusable	.2	.7	.0	.3	.0	.2
Other	1.2	1.5	.2	.1	.1	.6

We note however that many farmers are taking steps to protect their land, and/or making investments to make it more productive. Of the 12,596 plots described in the data, more than half (52.7%) have some form of conservation structure. Most common ones are stone terraces (mentionned in 36.5% of plots) and soil bunds (14.4%), while a small number (12.8%) have multiple types of structures. Differences between sites are notable in the REST area, where two thirds of all plots are protected by stone terraces; and in the SC/US area, where few of the methods used in the highlands are applied. We examine the determinants of conservation investment in more details in a later section.

[40] Ownership of grazin gland is communal in Ethiopia, whereas he plots referred to above are privately owned by households. This explains the low figures associated with pastures.
[41] The figures associated with fallow are of concern. There may have been technical difficulties in translating the concept to farmers. Also, many plots were simply not cultivated that year due to the drought.

Table 9.7. Types of fixed conservation investment (% of plots that have each type)						
% of plots with*	CARE	CRS	REST	SC/US	WVE	Average
No structure	49.8%	49.6%	26.8%	64.9%	55.8%	47.3%
Stone terrace	25.9	35.2	66.7	1.3	33.8	36.5%
Soil bund	18.7	26.1	16.0	1.0	7.3	14.4%
Check dam	2.9	2.3	2.7	1.6	2.0	2.4%
Drainage ditch	10.6	1.4	.7	1.8	.3	3.0%
Stone-faced trench	1.1	.2	1.4	.1	4.0	1.6%
Trees planted	1.5	.5	3.7	.3	1.1	1.0%
Grass strip	.7	.1	2.6	.3	.5	1.0%
Live fence	2.2	3.2	3.3	1.6	.6	2.2%
Other (unspecified)	.1	--	.1	8.5	--	1.1%

*Note: The total is greater than 100% as there may be more than one conservation structure per plot.

Some farmers also declared having made fixed productive investments to their plots[42], but this is less common. Most frequent fixed investments are to clear the land of stones, and to level the plot. Both measures are done to facilitate the preparation and working of the land, and we hypothesize that they are made in the best plots available to the farmer (we examine the determinants of investment in a later section). Investments are most common in the CRS area, followed by World Vision and CARE. Few farmers in the SC/US and REST areas made any such investments in their fields.

Table 9.8. Types of productive investments made (% of plots that have each type)*						
% of plots with	CARE	CRS	REST	SC/US	WVE	Average
None	81.6	71.0	91.5	83.8	82.7	82.8%
Irrigation well	2.2	0.6	2.8	0.3	0.4	1.4%
Irrigation canal	2.5	0.2	0.3	0.3	0.4	1.8%
Private pond	0.1	0.7	1.1	0.1	0.3	0.5%
Cleared of stones	11.7	19.7	5.2	0.3	14.3	10.7%
Leveled	3.8	12.4	2.4	0.8	12.0	6.5%

*Note: The total is greater than 100% as there may be more than one conservation structure per plot.

In addition to the conservation structures they build, farmers may use several types of cultural practices to improve the fertility of the land. The most common one is to apply manure (24% of plots), followed by the application of fertilizers (12.3%) and the plowing in of crop residues (9.2%). Other fertility enhancement techniques such as green manuring and mulching are infrequent. The relative importance of each technique varies quite substantially by CS area, however: in the CARE area, manuring and plowing in crop residues are the most widely used practices; whereas in the CRS, REST and WVE areas, the most important techniques are manuring and fertilizer application. Finally, hardly any farmer in the SC/US area uses any type of fertility management practices.

[42] It is not clear that production investments should be seen differently than conservation investments: after all, a conservation investment will not make much sense to a farmer unless it also provides productivity benefits. As the questions were asked separately in the survey, however, we report them separately here.

Table 9.9. Fertility management practices (% of plots where practice is used)*						
% of plots with:	CARE	CRS	REST	SC/US	WVE	Average
Burning to prepare field	.8	9.2	4.9	1.2	1.0	3.2
Manuring	22.8	28.7	24.2	5.5	32.4	24.1
Plowing in crop residues[43]	21.6	2.9	10.4	.2	1.4	9.2
Mulching	1.3	2.1	1.0	1.1	1.0	1.3
Alley cropping	1.0	--	.2	.2	.1	.4
Green manure	5.8	.8	1.8	.1	2.3	2.6
Reduced tillage/no till	.5	.1	1.4	1.3	--	.6
Fertilizer application[44]	2.9	19.7	27.2	.9	7.2	12.3

*Note: The total is greater than 100% as there may be more than one conservation structure per plot.

The next Table examines the type of fertilizer used by farmers. No fertilization was used in 65.2 percent of all plots. When used, it is mainly in the form of manure (18.7%) urea (6%) or DAP (a chemical fertilizer). DAP and urea were both used in 5.8% of plots. The differences between CS are again important, with farmers in the REST and CRS areas being the most consistent users of fertilizer, and farmers in the SC/US area being the least likely to use it. CARE and WVE stand in between those two extremes[45].

Table 9.10. Type of fertilizer used (of plots where each type is used)						
	CARE	CRS	REST	SC/US	WVE	Average
None	70.6	56.6	53.5	97.0	60.9	65.2
Urea	1.8	8.8	11.6	.9	5.6	6.0
DAP Formula	.1	11.7	1.6	.2	1.7	2.6
Manure	19.1	21.6	15.9	1.7	29.7	18.7
Compost	7.0	.7	1.6	--	.6	2.5
Organic and chemical mix	.1	--	1.6	--	.2	.5
Urea and DAP	.2	--	11.9	--	.8	3.2

Very few farmers (8.9%) mentioned using pest-control methods. In the few instances where this was used, chemical methods are prefered; IPM or organic methods are scarcely used at all. The only CS that stands out with regard to pest-control methods is CRS where farmers mentioned using chemical pesticides in a third of their plots.

[43] Plowing in is associated with crop type: it is more readily practiced with, say, wheat than teff or maize.
[44] The high level of fertilizer used in the CRS area surprised some, as this practice is not promoted by the program. However this sample refers to farmers in the area *before* the intervention started, so it may be true
[45] It has been noted that availability of chemical fertilizers in the market was very low that year due to the drought conditions.

Table 9.11 Type of pesticide used (% of plots where each type is used)						
	CARE	CRS	REST	SC/US	WVE	Average
None	95.0	64.7	92.8	94.9	98.0	91.1
Chemical only	3.1	33.4	3.9	4.7	1.4	7.2
IPM	.7	1.4	2.6	.3	.4	1.1
Organic	.1	.2	.2	.1	--	.1

With regards to the use of seeds, finally, our data shows that almost 95% of farmers use traditional seeds. Only in the SC/US area is this proportion slightly different, as 17.6% of farmers there mentioned using improved genetic materials. When examining the crops for which improved seeds are used, wheat and maize appear to be the only two crops where this is used in a meaningful way.

Table 9.12 Type of seeds used (% of plots where each type is used)						
	CARE	CRS	REST	SC/US	WVE	Average
Traditional	98.4%	91.1%	99.0%	82.4%	94.5%	94.7%
Improved	1.6%	9.0%	1.0%	17.6%	5.4%	5.1%
Crops for which farmers used improved seeds (only those with 3% or more listed)						
Maize	36.8%	9.9%	9.1%	57.7%	6.1%	
Wheat	38.6%	84.5%	42.4%	9.2%	83.0%	
Sorghum	3.5%	1.1%	3.0%	2.5%	--	
Teff	--	.6%	9.1%	8.4%	2.0%	
Barley	1.8%	2.8%	3.0%	1.3%	2.7%	
Beans	7.0%	--	--	17.6%	.7%	
Lentils	--	--	6.1%	--	.7%	
Onion	--	--	15.2%	--	--	
Carrot	--	--	3.0%	--	.7%	
Swiss chard	--	--	3.0%	--	--	
Potato	7.0%	--	3.0%	--	--	
Banana	--	--	3.0%	.4%	--	

The reduced use of technical inputs (fertilizers, pesticides, improved seeds) we have just documented certainly contributes a substantial element of explanation to the large gap that exists between the performance of farmers in our sample and that of experimental stations, as was discussed in the preceding Chapter. Opportunities for intervention are wide open and the promotion of improved production techniques is sure to be beneficial[46]. As we will see later on, however, it is not so much that farmers do not know about those methods or that they are not interested in them. Rather, their adoption of improved practices seems limited by a series of factor constraints (land, labor and capital). Improving agricultural performance therefore will

[46] Note however that one reason for the lack of interest in purchased inputs may be that farmers had a prior bad experience. This would make promotion more difficult. This issue should be studied *ex ante.*

require that the CSs find ways to circumvent those constraints at the same time as they train farmers in new methods.

Farm Characteristics

The second set of factors determining agricultural output, according to our conceptual framework, has to do with farm/household characteristics. Variables considered here include farm size, household wealth, access to family labor, and the household head 's characteristics (gender, technical know-how and level of education[47]).

Looking at farm size first, the traditional land redistribution system in Ethiopia guarantees that everyone has minimal access to land: this is largely reflected in our sample, where only 7.3% of households are landless. The counterpart to this, obviously, is that farms are very small, averaging just over half a hectare (.60ha) per farm. Farms operate 2.8 plots on average, each having a mean size of .22 hectare. Almost all of this (.21ha) is cultivated during the main rainy season (*meher*), but the proportion cultivated during the secondary rainy season (*belg*) is negligible (.01ha). Considering only the land effectively cultivated, the average farm operates a total of .57 hectare during *meher*, and .04 during *belg*. It is dubious that this can suffice to produce enough food for the whole family, particularly given the levels of productivity recorded in our sample. Land, therefore, is a serious constraint to household food production. A few interesting differences can be noted between CSs: beneficiaries of WVE have the largest amount of landless people (11%); and those in SC/US, the least number of landless (3.9%). The sites where farm are the smallest are SC/US (.40ha) and REST (.44ha); those where farms are the largest are WVE (.80ha) and CRS (.76ha). The greatest fragmentation of land appears to be in Tigray (3.37 plots per farm, each of them a minuscule .13ha).

Table 9.13: General farm characteristics (includes only households that have land)

		CARE	CRS	REST	SC/US	WVE	Average
% households with land[48]		93.3%	91.5%	93.7%	96.1%	89.0%	92.7%
Mean plot size in hectare		0.22	0.31	0.13	0.24	0.23	0.22
Mean n of plots per farm		3.00	2.43	3.37	1.68	3.48	2.78
Mean farm size in hectare		0.64	0.76	0.44	0.40	0.80	0.60
Mean plot surface cultivated in ha.	*Meher*	0.19	0.36	0.13	0.21	0.19	0.21
	Belg	0.018	0.004	0.001	0.063	0.004	0.089
Mean farm surface cultivated in ha.	*Meher*	0.55	0.87	0.45	0.36	0.67	0.57
	Belg	0.054	0.010	0.002	0.106	0.014	0.038

Another important determinant of agricultural performance is labor[49]. Access to family labor is hypothesized here to affect agricultural performance positively by allowing more intensive use of labor for the various agricultural tasks, holding all else constant. This indicator is assessed by counting the number of able-bodied persons aged 12 to 70 years residing on the farm. Table

[47] Household wealth and the education and gender of household heads were already discussed in previous Chapters, so there is no need to repeat this in the section on univariate analysis. We will however examine those variables in relation to their effect on yields and total output in the bi- and multivariate sections.
[48] There may be functional landlessness, however, as some households own only their homestead plot.
[49] We consider only family labor here, as wage labor comes as a cost and as such, is treated in the section on inputs.

9.14. shows that there are on average close to three available laborers per farm although we note that almost half the farms (46.5%) are operated by two persons or less. Labor may be a constraint for this latter group. Some differences are also noted between CS areas: SC/US stands once again as quite different than the other CSs with its larger mean labor pool size (reflecting the fact that household size is larger there than elsewhere, as already mentioned in Chapter Five).

Table 9.14. Size of family labor pool (N of working age persons living on the farm)

	CARE	CRS	REST	SC/US	WVE	Average
1	86 (9.2)	90 (10.2)	109 (12.5)	27 (2.9)	85 (9.6)	397 (8.8)
2	354 (37.8)	345 (39.2)	321 (36.7)	377 (40.8)	297 (33.6)	1694 (37.7)
3	183 (19.6)	168 (19.1)	194 (22.2)	153 (16.6)	206 (23.3)	904 (20.1)
4	133 (14.2)	124 (14.1)	130 (14.9)	134 (14.5)	151 (17.1)	672 (14.9)
5 +	180 (19.2)	153 (17.4)	121 (13.8)	232 (25.1)	146 (16.5)	832 (18.5)
Avge	2.96	2.89	2.81	3.18	2.97	2.97

Farmers' knowledge of improved farming techniques is also expected to have meaningful effect on agricultural performance, as such techniques are necessary to the process of intensification. The survey collected extensive information on this issue. Table 9.14, first, examines the types of modern techniques known by farmers in general. The types of improved techniques most often mentioned include planting techniques (row planting, etc); crop rotations; organic fertilization; seed selection or use of improved seeds; and soil preparation.

Table 9.15. Techniques known (% of farmers who mention knowing technique)

	CARE	CRS	REST	SC/US	WVE	Average
None	2.4	1.4	1.0	8.5	9.9	3.3
Crop rotation	11.9	15.5	11.3	8.3	23.0	13.4
Soil preparation	8.1	13.6	9.6	23.9	5.8	11.0
Seed selection, improved seeds	12.8	13.4	12.4	18.5	9.0	12.9
Intensive weeding	7.9	15.0	7.4	4.8	8.2	8.9
Chemical fertilization	9.7	8.9	15.0	1.5	15.0	10.8
Organic fertilization	17.3	12.0	13.5	3.9	10.3	13.0
Pest management	3.3	.3	4.7	.3	.3	2.4
Planting technique	20.8	17.0	19.2	29.6	10.1	19.2
Water management/irrigation	5.8	2.9	6.0	.7	8.4	5.1

The survey next asked respondents about the reasons for not using a technique they knew of, or for abandoning a technique they had previously practiced. Their answers are presented in Table 9.15. As farmers gave various reasons for not using a particular technique we group our discussion of their answers into four broad categories, namely: factor constraints; lack of interest; knowledge gap; and risk avoidance.

Factor constraints, first, are the most frequent reasons invoked by farmers for not using a particular technique. Credit constraints are mentioned as a limiting factor with regards to the purchase of modern inputs (improved seeds, fertilizers, and pesticides). Lack of labor (and lack of time, a factor probably associated with lack of labor) is seen as a main constraint hindering the

adoption of intensive weeding, soil preparation, crop rotations, organic fertilization, planting techniques, and water management (many of which are labor intensive). And lack of oxen (or lack of capital to rent oxen) is a limiting factor when it comes to using better land preparation techniques.

A second type of reason for not using a known technique is the lack of interest on the part of farmers for that particular technique, whether because he/she believes that there are better alternatives, that it is against the tradition, that it is not locally appropriate or that it is too complicated. This category as a whole is altogether of lesser importance, yet we note that there seems to be resistance against chemical fertilization (seen as not locally appropriate by 18.4% of respondents), or organic fertilization (13% said they had no interest in learning about it). Likewise, many farmers are either not interested in planting techniques such as row planting, or they do not perceive it as locally appropriate. The latter is interesting since, as we will see below, row planting is one of the techniques that was most widely supported by extensionists in the past. Is this failure of interest the result of disappointments? We cannot answer with certainty, but the data seems to indicate so.

In terms of knowledge, farmers mention quite often that the lack of technical assistance, their poor knowledge of a technique, or the complexity of a technique, is an element that stops them from adopting that technique (we return to this issue further below when we examine the extent to which extension services are present in the area). Risk, finally, is not something that is mentioned often, except for chemical fertilization.

In summary therefore, farmers rank factor constraints as the main impediment to the adoption of improved techniques. Lack of knowledge comes as a second preoccupation. Other factors such as poor interest, or risk avoidance, play a relatively little part in their answers. One may conclude therefore that farmers are willing to learn and even to take risk, but they need to overcome factor and knowledge constraints first. This provides useful indications to CSs about how to structure future extension services. The extent to which those services were present in the past is the issue we now turn to.

Table 9.16. Reasons for not using known agricultural techniques

	Credit	Oxen	Labor	Land	Time	Low interest	Better Altern.	Against tradition	Not loc. appropr	Too complex	Need TA	Know little	Risk	Other
Crop rotation	15.9	9.8	22.0	52.4	2.4	3.7	1.2		6.1	2.4	4.9	1.2	1.2	15.9
Soil preparation	10.0	12.0	24.0	24.0	6.0	8.0	2.0		6.0	2.0	12.0	8.0	2.0	10.0
Select/improve seed	38.2	1.9	5.6	9.9	.6	14.9	2.8	.6	11.2	1.9	6.5	7.1	4.7	12.1
Weeding	14.3	4.8	38.1	16.7	7.1		2.4			2.4	4.8			26.2
Chem Fertilization	46.5	1.2	3.3	11.1	.5	7.0	1.7	.2	18.2	3.1	5.1	5.0	8.8	15.4
Organic fertiliz'n	5.3	4.1	18.9	16.0	8.3	13.0	4.7	.6	3.6	8.3	9.5	10.1	1.2	13.0
Pest management	30.5	.8	3.4		.8	9.3	.8		4.2	1.7	32.2	8.5	1.7	10.2
Planting technique	9.7	5.1	16.3	24.3	12.2	16.1	5.4	1.2	12.4	3.2	10.7	5.8	1.9	5.8
Water mgmnt	12.2		10.2	33.0	4.1	1.5			4.1	5.6	19.8	2.5	2.5	26.4

Farmers were asked about the types of training they had received in the past, who the provider of that training was, and the intensity of training they had received in that particular technique over the last five years. Overall, 31.6 percent of farmers said they had been exposed to some form of extension training during those last five years. None of the techniques reached more than six percent of all farmers. The most frequent ones are fertilizer application (most notable in CRS areas) and techniques of planting/crop management (again, the CRS zone being the one that raises the average).

Table 9.17: Types of training received (% of farmers mentioning type of training)

	CARE	CRS	REST	SC/US	WVE	Average
Crop rotation/pruning	.5%	2.4%	.9%	2.2%	3.5%	1.9%
Soil preparation	1.7%	4.8%	.9%	3.5%	1.0%	2.4%
Seed preparation/selection	2.7%	5.0%	1.5%	2.8%	.8%	2.6%
Intensive weeding	.2%	1.0%	.3%	.4%	1.5%	.7%
Fertilizer application	8.6%	12.8%	3.9%	.9%	4.8%	6.2%
Organic fertilizer application	2.2%	4.3%	1.8%	.6%	2.1%	2.2%
IPM (integrated pest mgmt)	.6%	1.1%	.8%			.5%
Planting/crop management	3.1%	11.6%	1.3%	4.6%	4.5%	5.0%
Use of water/water diversion	1.7%	3.9%	2.1%	.3%	3.3%	2.3%
Terracing	4.7%	3.8%	.5%		7.8%	3.4%
Tree planting/nursery/agroforestry	1.6%	3.3%	1.0%	.2%	.4%	1.3%
Slope management	.4%	1.7%	1.5%	.4%	3.5%	1.5%
Enclosures, pasture reclamation	.4%	.1%	.1%		1.7%	.5%
Improved livestock breeds	1.9%	2.8%	.9%	.1%	.8%	1.3%
Livestock feeding	2.1%	.2%	.7%	.1%	.8%	.8%
Marketing techniques	2.2%	1.1%			.1%	.7%

As for who provided the training, the Bureau of Agriculture was the most important provider of extension services in the areas sampled, being mentioned by 80.4 percent of those who mentioned having been exposed to training in the past five years. The intensity of that contact was very reduced, however, with farmers reporting 3.5 contacts on average over the last five years with extension services.

Table 9.18: Provider of training (% of times provider mentioned)[50]							
		CARE	CRS	REST	SC/US	WVE	Average
PVO (NGO, CS, etc)		7.0%	11.1%	9.2%	45.5%	9.2%	13.0%
BOA		90.0%	86.7%	90.8%	24.6%	79.9%	80.2%
Friend/neighbor			.2%		1.1%	7.4%	1.8%
Other		3.0%	2.0%		28.9%	3.5%	5.0%
Mean number of contacts with extension agent	1997-1998	.76	1.99	.81	1.07	1.06	1.16
	1998-1999	.95	1.40	.87	.64	1.30	1.11
	1999-2000	1.15	1.01	.95	1.08	1.33	1.10
	2000-2001	1.16	1.43	1.25	.86	1.55	1.32
	2001-2002	1.13	1.53	1.08	.70	2.15	1.43
In total	1997-2002	3.11	3.94	3.42	1.56	4.16	3.48

To summarize on farm characteristics: few households in our sample are landless[51], but the amount of land to which they have access is probably not sufficient to produce the food they need to sustain their families through the year. For them, intensifying the use of land will be the only way to increase food output or agricultural income. Several constraints hinder this goal, however. First, the size of the family labor pool will constitute a critical constraint to intensification for about half of all farms. Hiring labor is a possibility but as we will see later, the reduced access to agricultural credit makes farmers entirely dependent on their savings to pay for such wage workers. Second, farmers appear to be aware of various intensive production methods but are critically limited in their adoption of those methods by their lack of access to capital. Again here, lack of credit acts as an important limitation to intensification. Third, many farmers mention the need for additional technical assistance or better knowledge of techniques, before adopting them. Unfortunately, their level of exposure to intensive methods is reduced. Agricultural extension services have not historically been enough of a presence to support large scale adoption of profitable techniques. Furthermore, the little extension that has been provided so far has been spent on a large variety of techniques, rather than on a few well identified ones. On the other hand, farmers show receptiveness to extensionists' messages. For agricultural extension to leave lasting trace, however, future extension programs will need to increase their level of presence; be organized around well defined production techniques; and ensure solid follow up.

Bivariate Relationships: the Determinants of Yields

Yields by Plot Characteristics

This section examines the individual effect that the determinants examined in the prior section have on yields[52]. This is the first step in the construction of the multivariate analyses found in

[50] It may have been difficult for responsents to separate BOA extension services from NGOs, as those agencies often work together.
[51] Although, as mentioned earlier, there may be some degree of "functional landlessness" at play.
[52] It would be too complex to present those bivariate tabulations by CS therefore the Tables and the narrative in this section do not make any distinction by CS. See Annex 2 for corresponding Tables by CS.

Chapter Ten. Findings in this section are therefore preliminary. To state our hypotheses briefly, plot level features are expected to affect yields as follows:

- The number of crops grown has an ambivalent relationship on yields: it has a negative impact as it reduces the amount of space available to each crop; but it has positive effects as it provides the associated crops with mutual benefits, such as organic fertility and physical support. Therefore its effect may be mixed.
- The quality of the soil affects yields as it is a proxy for fertility, which has a direct effect on the productivity of the land, and thus on yields.
- Topography affects the ease of use of the plot, as well as the quality of the soil.
- Irrigation improves yields by reducing the crops' exposure to moisture stress.
- The use of conservation measures improves yields as it helps protect the physical characteristics of the soil that contribute to its fertility.
- The tenure of the plot, finally, affects yields indirectly by influencing farmers' willingness to invest in that plot, thus affecting its productivity.

Those hypotheses are examined in Table 9.16. Looking at yields as a whole, we note that some of our hypothesizes appear to be verified by the data; but others are consistently not supported in this sample. First, our hypothesis about the effect of crop associations on yields is not verified. Intercropping has a significant effect on wheat, barley and beans; is marginally significant with regards to sorghum and teff; and has no apparent effect on maize, but the direction of the relationship is contrary to the expected in most cases (i.e. yields are higher when the plants are intercropped). Such mixed results may relate to the dynamics of crop associations: when intercropping, the crop planted first is usually in the same density as if it was planted in pure stand. Associated crops are planted later in the interstices of the grain crop, after the latter has taken root. Associated crops must therefore compete with established stands of maize or sorghum, and the higher the density of the grain crops, the greater the competition those legumes will face for micro nutrients, solar exposure and the like. The net effect is to increase yields variability, which may explain the non-significant relationships.

Table 9.19. Plot level determinants of yields (plots grown in pure stands and association combined)

	Maize			Wheat			Sorghum			Teff			Barley			Beans		
	$\overline{X}$	F	*P*	$\overline{X}$	F	*p*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*
Intercropped																		
- No	10.8	0.78	0.377	8.5	11.31	0.001	5.9	11.82	.066	6.6	3.38	0.06	6.8	10.63	0.001	6.5	6.49	.011
- Yes	11.4			10.3			7.7			7.9			8.1			8.0		
Soil quality																		
- Good	10.4	2.53	.080	7.9	11.05	.000	6.0	1.54	.216	6.4	1.82	.162	6.3	7.56	.001	6.3	2.03	.133
- Medium	10.5			10.3			7.0			7.3			7.3			7.5		
- Poor	10.2			8.8			6.2			6.7			7.8			6.9		
Topography																		
- Flat	9.9	6.60	.000	8.5	2.33	0.055	6.5	0.81	.518	6.8	2.25	.062	6.8	2.37	.050	6.3	3.54	.007
- Sloped	12.4			9.4			6.9			7.1			7.6			7.3		
- Steep	13.6			11.2			6.3			6.5			8.5			9.7		
- Mixed	9.9			8.7			6.6			4.8			6.1			7.2		

Plot irrigated																		
- No	10.8	5.73	.017	8.9	1.05	.305	6.6	.004	.950	6.7	0.02	.896	7.1	1.47	.225	6.8	0.88	.350
- Yes	14.8			7.0			6.5			6.5			5.6			8.2		
Tenure																		
- Unsecure	7.5	1.22	.270	7.8	0.89	.347	8.2	0.49	.483	4.9	2.62	.106	6.3	1.21	.271	6.5	0.05	.827
- Secure	10.9			8.9			6.6			6.8			7.1			6.8		
Use conservation																		
- No	10.5	1.94	.164	8.4	2.50	.114	6.5	0.11	.739	6.1	10.4	.001	6.5	5.98	.015	6.6	0.72	.397
- Yes	11.3			9.1			6.7			7.3			7.4			7.0		

With regards to soil quality, the coefficient is statistically significant but the relationships are non linear for all crops, with the "Medium" class being consistently associated with higher yieds than the "Good Quality" class. In our view this points to a measurement problem: perhaps our reclassification of farmers' categories into Good, Medium and Poor does not do justice to the indigenous system—e.g. local categories may refer to types of soils rather than fertility. Second, the indigenous categories may themselves be arbitrary in the first place. No matter the reason, however, it is disappointing to realize that this variable is unreliable, as soil quality is typically a key determinant of yields.

With regards to topography, slope appears to have the expected effect on yields of all crops except sorghum: the lesser the slope, the higher the yield. This supports our hypothesis. The lack of association with sorghum yields may be due to the fact that sorghum is a rustic crop, well adapted to difficult conditions. As such, farmers may reduce their use of that crop in their best land, and keep it for the more inclined plots.

The presence of irrigation positively affects maize but not the other crops. Recall however that very few of the plots are irrigated. The very small number of positive responses may dilute te trend. Also, several of the crops (sorghum and teff, particularly) are drought resistant and would provide relatively similar yields whether they are irrigated or not.

Conservation measures seem to affect only teff and barley. The direction of the effect is as expected, i.e. the presence of conservation measures is associated with higher yields for those crops. It has no effect on other crops, however. Some additional considerations may help interpret this data: as we will show later, conservation structures are essentially implemented in plots with mid to high inclinations, not in flatter lands where the best yields are obtained. Thus, the lack of association between the presence of conservation structures and yields is more likely signaling that the land where the crop is grown is fragile, rather than that conservation is useless. To correctly interpret the effect of conservation structures, we have to control for the slope and soil quality, which is done in Chapter Ten[53].

Security of tenure, finally, has no effect whatsoever on any of the crops. This suggests that no more attention is given to owned plots over rented or borrowed ones. It may be that the traditional tenure system provides enough guarantees for farmers to not fear losing their access—

[53] In addition, it should be noted that survey was done in areas where soil fertility is generally poor. Other surveys done in Ethiopia on the impact of conservation structures on production found that conservation structures are positively correlated to yield and production, especially in areas where soil fertility is good.

which would lead them to treat all their lands similarly, thus explaining the lack of effect of this variable on performance. Perhaps also the simple production techniques used by farmers do not allow for much variation in cropping methods.

Yields by Farm Characteristics

In this section, we explore the effect of farm characteristics on agricultural performance. Farm characteristics considered include farm size, access to family labor, household wealth, the gender, technical knowledge and level of education of the household head. To summarize our hypotheses briefly:

- The size of the farm influences yields positively as it offers farmers more options in selecting the best plot for each crop. Also, being an indication of wealth, it reflects the farmer's capacity to invest in inputs or in making improvements to the land.
- The wealth of the household affects their capacity to invest in purchased inputs, labor and fixed infrastructure. All of those in turn are expected to improve performance as they are generally seen as the necessary ingredients of agricultural intensification.
- Access to family labor affects agricultural performance by allowing more intensive application of labor to the various agricultural tasks.
- Gender of the household head affects performance as a female head may have more difficulty using the traditional networks of labor exchange. Female farmers may also be at a disadvantage for specific tasks like plowing, bush clearing and land preparation, which involve hard physical labor and are traditionally done by men.
- Education is expected to affect the farmer's capacity to obtain and use information

The results from our examination of those hypotheses are presented in Table 9.14. Total farm size has a significant effect on yields: surprisingly, the data indicates that the most productive farms are not the larger ones, as we had hypothesized, but the smaller ones. This suggests that smaller units are farmed more intensively and/or more efficiently than larger ones. Two factors may help explain this: first, smaller units may farm their land more intensively because they depend more highly for their survival on the little land that they have. Second, access to labor may exert a constraint on farming capacity: assuming household size to be constant across farm types, larger farms will have less access to family labor per unit of land than smaller farms, and will be less able to work all the land at their disposal, unless they hire outside labor.

Household wealth by contrast, does not appear to have any effect on the yields of the crops examined: the trends are not linear and the p values are insignificant. This is somewhat surprising, as wealth is usually associated with the capacity to invest, and with access to credit and labor. Maybe the number of farmers who use technical inputs is too small to make a difference. Also, given that farm size (a key component in the index of wealth) goes contrary to our expectations it may counteract the other elements within that index that might go along with our hypothesis, thus explaining the inconclusive result.

Table 9.20. Farm level determinants of yields (plots grown in pure stands and association combined)

	Maize yield			Wheat yield			Sorghum yield			Teff yield			Barley yield			Beans yield		
	$\overline{X}$	F	*p*	$\overline{X}$	F	*p*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*	$\overline{X}$	F	*p*	$\overline{X}$	F	*p*
Size of the farm																		
- Smallest	14.1	26.11	.000	11.7	52.3	.000	8.0	3.89	.021	8.8	18.5	.000	9.4	48.7	.000	7.6	2.42	.089
- Middle	11.0			9.6	4		6.7			7.1	3		7.2	5		7.0		
- Largest	8.8			6.6			5.9			5.7			5.4			6.3		
Wealth																		
- Lowest	10.6	1.17	.310	8.3	2.36	.095	6.2	1.66	.191	6.8	0.37	.691	7.2	0.57	.565	6.2	0.57	.565
- Middle	11.4			8.6			7.2			6.9			6.8			6.2		
- Highest	10.5			9.4			6.2			6.6			7.2			7.5		
N of family labor																		
- Low	10.9	0.04	.961	9.0	0.37	.692	6.8	1.39	.251	7.0	2.93	.054	7.1	0.10	.906	6.7	0.22	.802
- Middle	10.8			8.6			6.2			6.2			6.9			7.0		
- High	10.8			8.4			5.5			5.6			7.2			6.4		
N of family labor/ha																		
- Low	8.8	24.48	.000	6.6	54.1	.000	6.1	1.60	.203	5.9	8.94	.000	5.4	54.9	.000	6.1	4.13	.016
- Middle	10.4			9.3	0		6.6			7.4			6.7			6.9		
- High	13.5			11.8			7.3			7.6			7.6			7.8		
Received training																		
- No	10.9	0.35	.556	9.0	1.48	.223	6.5	0.32	.574	6.8	0.50	.482	7.3	10.8	.001	6.8	0.33	.564
- Yes	10.4			8.3			6.9			6.4			5.9			6.5		
Education of HHH																		
- None	10.2	0.90	.442	8.9	1.61	.185	6.3	0.20	.896	6.7	0.86	.460	7.3	1.00	.391	6.7	1.10	.350
- 1 yr/literate	8.1			8.7			7.5			8.6			6.4			6.3		
- 2-3yrs	10.6			7.6			6.5			6.9			6.4			5.9		
- 4 years and +	11.3			7.7			6.6			7.2			6.7			7.8		
Gender of HHH																		
- Male	11.0	2.42	.120	8.9	0.40	.529	6.5	0.35	.557	6.7	1.20	.274	6.9	2.21	.137	7.0	3.94	.047
- Female	9.7			8.6			6.9			7.2			7.7			5.7		

The findings related to the family labor pool are interesting. The size of the family labor pool in itself is not a significant determinant of yields for any crop (except marginally for teff). Controlling for farm size, however, the relationship changes dramatically: the higher the number of family members working on each hectare of land, the higher the yield. This is true for all crops except sorghum. The difference in labor intensity appears to be most critical for wheat yields: farms with the highest access to labor produce almost double than those with the lowest access to labor (6.6 quintal versus 11.8 quintals). The difference is also striking with regards to maize (8.8 verus 13.5 quintals respectively). This suggests that labor may be one of the most critical constraints limiting farming performance under the type of technology used. Overcoming this constraint involves either finding ways to increase the application of labor to the land; or else, promote the use of labor-saving devices. Note here that both those solutions require access to production capital: since we already took into account family labor, any increase in the application of labor will by necessity involve hiring farm hands, which requires capital. Conversely, the application of labor saving devices such as oxen plowing or chemical weeding will also require the use of capital. Thus access to production capital may be the most critical factor in overcoming the labor constraint.

The other farm characteristics we analyzed include the training received, and the education and gender of the household head. Results suggest that the fact of receiving training has no influence on yields. This comes as no surprise since, as we mentioned earlier, the training affected very few farmers and was superficial, lasting only a few days in each case. Given those conditions, it would be surprising to see extension have any effect on farm productivity. Education of the household head does not seem to affect performance either, nor does the gender of the household head.

Factors Affecting Land Use

In the following paragraphs, we examine various factors that appear to influence farmers' use of the land and their willingness to invest in conservation. Looking at land use first, not all plots appear equally likely to be cultivated. A number of factors have been mentioned in the literature that may induce farmers to favor a particular plot over another when making production decisions. Soil quality and topography are often cited as strong determinants of a farmer's decision to cultivate land, as those aspects promise both greater production and easier labor.

Table 9.21 Percent and surface of plots cultivated by soil quality and topography

	N of plots (%)	Percent of all plots that are cultivated[1]	Area of each plot that is cultivated[2]
Soil quality			
Good	4578 (37.0%)	79.9%	77.8%
Medium	3634 (29.4%)	76.7%	74.9%
Poor	4161 (33.6%)	77.9%	76.9%
Plot topography			
Low inclination	7980 (65.6%)	76.8%	75.3%
Medium inclination	3551 (28.7%)	83.0%	80.8%
Strong inclination	634 (5.12%)	80.1%	78.6%

[1]Soil quality ChiSq=12.886, p=.002; Topography ChiSq=57.727, p=.000
[2]Soil quality F=5.147, p=.006; Topography F=22.248, p=.000

The hypothesis that a given plot's soil quality determines a farmer's decision to use is not supported in our sample: the decision to cultivate a particular plot (i.e. to put it under annuals or perennials) does not seem to be affected by its quality or slope, nor is the proportion of the plot that is cultivated. The relationship between those variables is significant but the trend is not in the expected direction, which defeats our hypotheses. The problem we raised ealier with soil quality may affect this result. It may also be that access to land is too constrained to leave much choice to farmers: whatever they have they will cultivate to the greatest extent possible.

Social factors such as the tenure of the plot, the household's socio economic status and the total size of the farm are also invoked in the literature to explain a farmer's decision and propensity to invest in one plot or not. As we mentioned earlier, the hypothesis here suggests that insecure tenure will discourage investment, as the farmer runs the risk of losing the capital invested if access to that plot is contested. Secure tenure, by contrast, should stimulate investment. The extent to which these relationships hold in our sample is investigated below. We expect security of tenure to be positively associated with both the likelihood of putting a plot under cultivation, and with the proportion of the plot that will be under cultivation.

The wealth of the household is also expected to affect land use because it determines how much resources (inputs, but also fixed capital investments) the farmer can mobilize to work that plot. Also, wealth is often associated with more educated and more progressive farmers. For all those reasons, we expect household wealth to be a positive predictor of output: the greater the farmer's wealth, the more likely this farmer is to apply labor and other inputs to the plot, and the more productive that plot will be.

Table 9.22 Percent and surface of plots cultivated by social factors

	N of plots in that class (%)	Percent of all plots that are cultivated[1]	Area of each plot that is cultivated[2]
Land tenure			
Secure (purchased, inherited)	593	78.5%	76.8%
Not secure (rented, sharecropped)	11,780	75.4%	74.4%
Household wealth			
Poorest tercile	2,906	71.2%	69.5%
Medium tercile	4,240	79.3%	77.3%
Wealthiest tercile	5,206	81.4%	80.0%

[1]Land tenure ChiSq=3.162, p=.075; Household wealth ChiSq=117.162, p=.000
[2]Land tenure F=1.878, p=.171; Household wealth F=60.925, p=.000

Our hypotheses about social factors influencing the use of the land are only partly supported by the data. In the case of tenure, security of access has a marginal effect on whether a plot is cultivated or not (which supports our hypothesis); but tenure security does not significantly affect the proportion of each plot that is cultivated. The wealth of the household, on the other hand, positively and significantly affects those two variables: the wealther is the household, the more likely it is to use its land. This latter finding is somewhat counterintuitive, in the light of our earlier analysis which showed that smaller farms cultivate the land more intensely than larger farms. We could thus expect that they are more likely to cultivate what they have than if they had more land. This does not appear to be the case, however.

Factors Affecting Land Conservation

It is hypothesized here that the main factors affecting farmers' decision to invest in land conservation include: the quality of the plot (better plots receive more attention because they have more potential); topography (steeper slopes need more protection from erosion); current land use (more intensely cultivated plots receive more investments); land tenure (more secure plots invite greater investments); and household socio economic status (wealthier households have more capacity to invest).

Several of the hypothesized relationship are significant, but they do not always go in the expected direction, or are not always linear. Behavior contrary to the expected is seen in a few cases. More specifically:

- Conservation structures are more likely in plots of mid slope than in plots of reduced or high slope. The fact that flat lands receive less conservation investment is not surprising, as there

is less of a need for it. That steeper slopes are less likely to be protected than mid-slopes is unexpected, however. Yet recall (from Table 9.xx above) that farmers are slightly less inclined to cultivate steep plots than mid-slope ones, which may explain in part this finding. This preference may carry into their investment patterns.

- Soil quality differences are significant but again, the trend is not linear, which raises doubts about the reliability of this variable. We do not consider this issue further here.
- Plots that are actively cultivated also tend to receive more conservation investment.
- The two social factors (land tenure and household wealth) both show strong association with consevation investment: secure plots are more likely to be protected with conservation investment; also, wealthier households are more likely to do such investment in their plots. Those findings are as expected.
- Irrigation investment seems less responsive to the hypothesized determinants than conservation. The quality of the soil, the security of tenure, and the wealth of the household have no significant effect on farmers' investment pattern in irrigation. The only elements that appear to matter are plot topography, and whether the plot is actively cultivated or not. The latter finding was expected but the first one (topography) is curious as the direction of the relationship goes contrary to our expectation: the steeper the plot the more likely it is to be irrigated. Note however that the numbers involved are very small, possibly creating data artefacts. There are not enough occurrences to permit accurate prediction of farmers' decision in this regard..

Table 9.23. Factors affecting investment in land conservation and irrigation

	N of plots in that class (%)	Proportion with Conservation	Proportion with Irrigation
Topography			
Flat	7,980 (65.6%)	48.3%**	1.9%*
Gently sloped	3,551 (29.2%)	60.7%**	2.5%*
Steep	634 (5.2%)	54.1%**	2.7%*
Quality of soil			
Good	4578 (37.0%)	49.8%**	1.8%
Medium	3634 (29.4%)	54.0%**	2.3%
Poor	4161 (33.6%)	50.9%**	2.3%
Utilization of plot			
Cultivated	9690 (78.3%)	57.3%**	2.7%**
Not cultivated	2683 (21.7%)	30.2%**	
Security of Tenure			
Secure	11780 (95.2%)	51.8%**	2.1%
Not secure	593 (4.8%)	42.8%**	1.9%
Socio economic status of household: domestic assets			
Poorest tercile	2906 (23.5%)	47.6%**	1.6%
Medium tercile	4240 (34.3%)	51.2%**	2.3%
Wealthiest tercile	5206 (42.1%)	53.6%**	2.2%

**: Significant at the .05 level *: Significant at the .10 level

All the above bivariate relationships will be further tested using multivariate methods in Chapter Ten, but it seems warranted at this point to draw a few conclusions: farmers in our sample appear

to invest rationally in conservation by chosing those plots that they cultivate and are located mid-slope. We also note that wealthier households are more likely to do such investments. Irrigation investment is more difficult to describe, most probably because irrigation is found so infrequently. By and large, however, it appears that interventions based on received theory would work in the CS areas: farmers will invest in conservation in those lands where they can see the benefits of this investment and they will invest in the plots that they actually use. The cost of investment may however deter poorer farmers, and so CSs must use alternative incentives than the promise of productivity improvement to bring farmers to do such investments. Programmatic interventions can be designed taking those issues into account. Food for Work, for instance, might be seen as an appropriate incentive.

Total Production by Farm Characteristics

In this section we look at the farm level determinants of total production. Total production is expressed first as the total amount in quintals produced for each or the main crops grown on the farm; then total output per crop is standardized using Kilocalories equivalent. Those values are next summed across all crops to derive the total amounts of foodstuff (Kcal) produced by the farm. An additional computation is made that divides the total Kcal produced by the household Kcal requirements, to represent the proportion of the household Kcal requirements that are satisfied by the farm production. Table 9.24 begins our analysis by looking at the hypothesized determinants of production by crop.

Table 9.24. Farm level determinants of total production by crop

	Maize			Wheat			Sorghum			Teff			Barley			Beans		
	$\overline{X}$	F	*p*	$\overline{X}$	F	*p*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*	$\overline{X}$	F	*P*
Size of the farm																		
- Smallest	3.58	.892	.410	3.55	.312	.732	2.11	.248	.781	2.42	.259	.772	1.49	2.115	.121	1.04	1.356	.258
- Middle	4.54			4.92			2.95			4.03			4.49			1.98		
- Largest	23.77			4.57			2.64			4.28			6.13			3.03		
Wealth																		
- Lowest	2.69	.732	.481	3.82	.140	.869	2.44	.141	.868	1.87	1.891	.151	2.61	1.877	.153	.73	1.930	.146
- Middle	5.23			4.39			2.96			2.63			3.17			3.20		
- Highest	21.53			4.77			2.57			5.92			6.43			2.37		
Access to family labor																		
- Low	15.06	.276	.759	5.27	1.599	.202	2.96	.474	.622	3.73	.079	.924	4.65	.194	.824	2.94	1.473	.230
- Middle	3.42			2.93			2.15			4.40			4.27			1.33		
- High	8.95			1.71			2.10			2.97			1.82			1.66		
N HH members/ha																		
- Low	25.91	1.028	.358	4.25	.396	.673	2.54	2.302	.101	3.42	.688	.503	4.70	.034	.967	3.57	2.693	0.068
- Middle	3.69			5.25			3.63			3.28			4.39			1.55		
- High	4.86			3.76			1.32			6.09			4.12			1.34		
Received training																		
- No	12.27	.132	.717	4.30	.162	.687	2.77	.465	.495	3.87	.001	.978	4.35	.036	.849	1.94	3.252	.072
- Yes	4.88			4.97			1.95			3.94			4.78			3.98		
Education of HHH																		
- None	14.10	.086	.968	3.89	1.309	.270	2.64	1.48	.329	4.04	.028	.994	4.78	.137	.938	2.43	.171	.916
- 1 year/literate	3.80			1.99			8.14			2.53			.81			.58		
- 2-3yrs	5.41			4.24			2.25			3.56			5.41			1.62		

Table 9.24. Farm level determinants of total production by crop																		
	Maize			Wheat			Sorghum			Teff			Barley			Beans		
- 4 years and +	3.56			7.88			2.19			4.36			3.96			2.84		
Gender of HHH																		
- Male	12.34	.194	.660	4.31	.213	.644	2.69	.018	.893	4.15	.438	.508	4.36	.026	.873	2.22	.430	.512
- Female	2.38			5.17			2.53			2.52			4.73			3.06		

None of the hypothesized determinants of production behave as expected: our data shows that the size of the farm, the wealth of the household, the size of the labor pool, the exposure to extension, the education and the gender of the household head do not explain total production for any of the crops when considered individually. One reason why this may be is that there are so little differences in average farm size. Given that and the traditional technologies used, not much variation in production can be obtained from one farm to the next.

Table 9.19 examines the total quantities of Kcal produced on the farm and the proportion of household Kcal needs filled by own production[54]. Except for exposure to training, and for the education of the household head, all the farm level relationships we hypothesized to affect total production appear here as important determinants of the total Kcal produced. Most hypothesized determinants of the proportion of Kcal RDA produced are also verified, except for training, and gender of the household head.

Table 9.25: Farm level determinants of total kilocalories and of proportion of HH Kcal needs						
	Total Kilocalories produced			*% of kcal RDA produced*		
	$\overline{X}$	F	*p*	$\overline{X}$	F	*P*
Size of the farm						
- Smallest	558,788	206.5	.000	19.9%	85.01	.000
- Middle	1,012,371			28.9%		
- Largest	1,729,031			41.4%		
Wealth						
- Lowest	617,317	156.27	.000	25.5%	20.19	.000
- Middle	1,072,506			30.8%		
- Highest	1,653,622			36.2%		
Access to family labor						
- Low	1,042,823	34.75	.000	33.5%	9.33	.000
- Middle	1,392,074			27.7%		
- High	1,750,630			25.3%		
N of HH members/ha						
- Low	1,598,717	105.47	.000	44.9%	139.24	.000
- Middle	1,093,024			28.7%		
- High	744,698			18.3%		
Received training						
- No	1,132,563	16.27	.000	31.4	.046	.831

[54] To recall from Chapter Eight, the Proportion of HH needs ponders total household production by the number of persons living in the household, taking into account their gender and age.

Table 9.25: Farm level determinants of total kilocalories and of proportion of HH Kcal needs						
	Total Kilocalories produced			*% of kcal RDA produced*		
	$\overline{X}$	F	*p*	$\overline{X}$	F	*P*
- Yes	1,411,103			31.8		
Education of HHH						
- None	1,114,417	5.88	.001	30.3	2.49	.059
- 1 year/literate	1,499,557			37.9		
- 2-3yrs	1,412,493			35.2		
- 4 years and +	1,338,642			34.7		
Gender of HHH						
- Male	1,267,804	71.17	.000	31.3	.535	.464
- Female	722,993			32.6		

Summarizing the bivariate analyses above, the effect of the various determinants on yields appears to vary by crop. Intercropping, soil quality and topography all seem to have a significant effect on yields whereas the other factors we examined at the plot level—the use of conservation structures, irrigation and the tenure of the plot—showed no effect whatsoever on any of the crops. With regards to the farm-level characteristics, total farm size has a significant effect on productivity but surprisingly, this effect is negative, suggesting that the most productive farms are not the larger ones, as hypothesized, but the smaller ones. Smaller units are thus farmed more intensively and/or more efficiently than larger ones, an important consideration for the design of future extension interventions. Another farm level factor that impacted on yields is the size of the family labor pool in relation to farm size, suggesting that labor may be a critical constraints limiting farming performance. Programs should either find ways to increase the application of labor to the land; or else, promote the use of labor-saving devices. Factors such as household wealth, the training received, and the education and gender of the household head, had no influence on yields. The lack of impact of exposure to training is probably explained by the fact that extension affected few farmers, and those who were exposed had very minimal training.

With regards to total production by main crop, none of the hypothesized determinants was shown to have a significant effect on the outcome. This is surprising, but it may be that the agroecological diversity and variability in production conditions across the sample impede us to see the main trends in this respect. This suggestion is made more compelling by the fact that Total Kcal produced, which is a proxy for total farm production, is by contrast very strongly influenced by most of the hypothesized determinants and to support the findings above. Total Kcal produced, as well as the proportion of the Kcal RDA produced by the farm, are both influenced by the size of the farm, the wealth of the household, the relative size of the family labor pool, the gender of the household head and the education and training of the household head. Chapter Ten, which examines the determinants of outcomes in a multivariate context, will provide more definitive findings on the relative importance of each of those factors.

Univariate Statistics on Economic/Institutional Determinants

The third set of factors determining agricultural output, according to our conceptual framework, is the institutional/economic context in which production takes place. Given that few or no economic incentives are used by the government in Ethiopia to promote production, the main institution to be considered here is the market itself. This term can be made to encompass a wide

array of elements. Here we will simply refer to the activities that involve monetary exchanges, including the purchase and use of inputs, the sale of outputs, and the sites where those inputs and outputs are bought and sold.

Access to and Use of Agricultural Inputs

We use the term "inputs" here in reference to: a) the organic or chemical products that enhance production (fertilizers, pesticides and improved seeds); b) the labor that goes into production; c) and the capital used to purchase those commodities. We do not have information on actual supply, demand or prices for those inputs, therefore our discussion is very brief and summary.

Assuming that distance to markets or agricultural input supply stores is a reasonable proxy for availability of inputs, then farmers in our sample appear to have a relatively poor access to commercial inputs such as fertilizers, pesticides or improved seeds: as was previously described in Chapter Five, under the section "Access to Services", weekly markets are found at a mean distance of 15 kilometers; and agricultural supply facilities at a mean distance of 27 kilometers. Given the generally poor transportation system, that distance usually has to be covered by foot or animal, and the prospect of having to transport heavy bags of fertilizers over that distance may deter many from doing so. This may explain in part why the use of fertilizers, pesticides and improved seeds by farmers in our sample is so reduced: the use of technified inputs may be as much related to their availability as it is to capital and knowledge limitations. That situation is particularly acute in the SC/US area, where agricultural input stores are as far as 80 kilometers away on average.

The second important input to production is labor. Farmers in Ethiopia use very little wage labor. Overall, family labor only was used in 88.7% of all plots; while wage labor was used in only 5.3% of all plots. In the remaining 6% of plots, farmers used a combination of family and wage labor. Thus, it appears that labor markets are very weakly developed. Labor being a critical element in agricultural intensification, the Title II programs could aim at further facilitating labor flows first by recognizing the importance of traditional self-help or solidarity networks and strengthening such networks whenever possible; and second by improving access to credit, to help farmers purchase salaried labor. Stimulating the rural labor market through better credit access would further help improve local earning prospects for households that have an oversupply of labor.

Table 9.26. Type of labor used over all plots

	CARE	CRS	REST	SC/US	WVE	Average
Self and family labor only	90.5%	85.7%	93.5%	96.8%	78.2%	88.7%
Part self/family, part paid labor	4.8%	12.0%	4.8%	3.0%	6.5%	6.0%
Paid labor only	4.7%	2.3%	1.6%	.2%	15.3%	5.3%

The third type of input we discuss here, production capital. essentially refers to credit and/or personal savings. Access to such capital is crucial in acquiring the other means of production, be they improved seeds, fertilizers, pesticides or salaried labor. This is particularly true for small holders, who typically dispose of little accumulated savings, if any. Unfortunately, information on farmers' access to and use of productive capital is again limited in this survey, and we can

offer only a superficial analysis of its importance in the process of production. The data provided by the survey on credit considers only whether credit resources were or not used in the exploitation of a particular plot, and the source of that credit. It does not report on the size of the loan. Similarly, no data is provided on the amount of savings available, nor how much was invested into production. The only way we can study savings is by using the previously discussed indices of domestic wealth as proxy for accumulated savings.

Credit was used by 15% of all households in our sample during the year of reference; and it was used in 11% of the instances of production mentioned. When capital is needed, the source of the funds are most usually the Bureau of Agriculture or the farmers' own savings. Other sources such as banks, coops, NGOs, moneylenders or friends and relatives are mentioned infrequently. The crops for which loans are sought are most usually teff (23.5% of the loans), wheat (17.7%) or barley (11.7%).

This general outlook suggests that credit is sorely lacking in the intervention areas. There is no information on the size of the loans, but the type of source most frequently used (BOA, own savings, families or friends) suggest that the size must be small. Lack of access to capital may therefore act as a key constraint to the use of productive inputs, and consequently to the intensification of agricultural production.

Table 9.27. Availability and Use of Credit by CS

	CARE	CRS	REST	SC/US	WVE	Total
% plots where credit used *	4.2%	16.4%	19.8%	7.6%	6.7%	11.0%
% HHs that used credit	9.2%	16.8%	32.1%	7.5%	10.7%	15.2%
Source of capital						
No capital needed	80.0%	42.1%	44.3%	68.1%	78.3%	62.2%
Own savings	10.2%	14.9%	22.0%	21.9%	5.8%	15.5%
Bank		.1%	3.3%		.1%	1.1%
Bureau of Agriculture	4.5%	41.5%	23.5%	.4%	13.6%	15.8%
Coop/Association	1.9%		2.3%		1.0%	1.3%
NGO (incl. CS)		.1%	3.2%	.6%	.5%	1.2%
Moneylender	1.2%	.2%	1.1%		.3%	.7%
Friends/relative	2.2%	1.0%	.3%	9.0%	.4%	2.2%
Crops for which credit was used						
Maize	2.8%	5.4%	8.9%	10.6%	3.9%	6.5%
Wheat	16.4%	21.6%	22.0%	2.1%	12.6%	17.7%
Sorghum	.2%	1.5%	6.2%	19.1%	3.8%	2.8%
Teff	5.9%	49.1%	34.5%	1.2%	5.6%	23.5%
Barley	4.2%	19.0%	17.0%	1.1%	7.9%	11.7%
Beans	3.8%	7.8%	4.5%	6.7%	3.0%	4.6%

* Does not include funds from own savings

In summary, this section has shown that farmers in our sample usually live relatively far from input suppliers. This may create a problem with the availability of modern inputs, possibly explaining in part why they are used so rarely. Another factor that may come into play is that

farmers have very limited access to production capital. Finally knowledge about the proper use of inputs may be inadequate, discouraging many from using them. All those various factors may contribute to the farmers' reduced propensity to use modern inputs, which in turn translates into a reduced capacity to intensify production and obtain higher yields (those aspects are considered at greater length in Chapter Ten). Title II programs may consider a number of actions to correct this situation. First, CSs should concentrate their agricultural extension efforts on techniques that improve the soil's productive capacity, while reducing the need to use capital in the purchase of external inputs. It may be worth researching whether organic production methods that increase soil fertility, such as green manure, residue incorporation and zero tillage find acceptability in Ethiopia as this may help reduce the severe capital constraints that seem to affect farming enterprises in Ethiopia. In attempting to improve farmers' access to production capital, the Title II program (who are not a good resource for credit), should identify institutional partners to team up with in order to improve credit access in the context of their own agricultural interventions. Increasing credit availability should improve the farmers' capacity to acquire needed inputs, help create rural jobs, and help improve production performance in the fields.

Output Markets

Agricultural markets are important in the CS areas: Almost half (46.5%) of all the agricultural production from our sampled farms was sold on local markets, and most farmers (70.6%) sold at least some of their production during the 2001-2002 agricultural year (Table 9.22). In this section we look at some features of those output markets.

In terms of market volume and market value, food crops are the most important commodities in rural markets: among our main crops, maize generates 26.2% of the value of all sales, beans represent 16.9%, peas 11.3%; sorghum 13.2% and peanuts represent 7.8% of the value of all sales (last column, Table 9.22).

Table 9.28: Crops sold by farms in CS areas [55]

Crop	Total N HHs growing crop	Total N HHs selling crop (%)	Mean value of sales per farm	Monetary equivalent of production per farm*	% of total sold**	Total value of sales (all farms)	Total value of prod'n (all farms)	% of all prod'n sold
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Maize	29.6	4.3	41.69	505.80	4.01	61,411.12	745,038.21	8.2%
Wheat	33.1	7.1	36.56	298.58	5.92	57,325.45	468,174.98	12.2%
Sorghum	13.4	2.9	35.68	494.57	9.65	23,117.54	320,480.81	7.2%
Teff	25.7	8.8	62.02	375.92	12.26	76,901.72	466,143.51	16.5%
Barley	34.2	5.2	14.90	230.94	7.48	24,041.82	372,742.49	6.4%
Beans	18.2	6.2	38.80	133.46	18.54	34,808.00	119,709.94	29.1%
OVERALL			74.85	671.96	8.23	277,605.65	2,492,289.9	11.1%

*All monetary values are in Ethiopian Birr. In 2002, US$1=8.5EB (approximately)
** Computed by dividing column 4 by column 5.

[55] The values in the five last columns were computed by converting the agricultural production of the household in monetary equivalent using the crops' shadow costs. Shadow costs themselves were provided by survey data for the season and region of interest, as obtained from AGRIDEV. This provided the corresponding values: in EB maize, and sorghum are both valued at … EB per kg; wheat at… etc. Multiplying the total household output in lb for those crops by their respective values and summing up those values together provides a monetary equivalent for household agricultural production.

The crop that is most widely sold in Ethiopia is teff: 8.8% of all teff producers sold their produce, putting on average 12.26% of all their production on the market for a mean value of 62 EB per farm. It is followed by maize, sold by 4.3% of producing farms; then by wheat, sold by 2.9% of wheat producing farms. Other crops (sorghum, barley and beans) are also sold by some farmers but the aggregate value of their sales on the market (column 7) is less. Those data suggest that agricultural markets play a relatively little role in support of rural livelihoods. Pure cash cropping is virtually unknown among farms in our sample: cash crops like fruits, vegetables or coffee were produced by very few farmers (see Table 8.1) and were grown mainly for consumption purpose. Thus farmers in our sample appear to be mainly subsistence producers who occasionally sell produce on the market, probably when they have surpluses or when they need cash. Note that, as we already mentioned, 2002-2003 was a highly atypical year due to the drought conditions. It may be that under those circumstances, the value of food "as food" is greater than once converted to cash[56].

Data in Table 9.22 also allow us to take a look at the relative importance of various crops in local agricultural markets. Column 7 shows that of the six main grain crops, teff is the one that weights the most in terms of traded value, although it is not the one that is produced most. Other crops like maize and wheat are more important in terms of aggregate production, but they are sold by fewer farmers, and a smaller proportion of the output enters commercial markets.

Revenues generated by sales remain very small for most households: using shadow prices, farmers on average earned 75EB (US$9) during the entire 2002-2003 agricultural year from crop sales. It is unlikely that agriculture as currently practiced can provide the monetary income needed to compensate for the low levels of staple crops production. Yet, it still seems important to better understand the conditions faced by farmers when they sell their crops: why do they sell so little? Can they take advantage of good market conditions? How well informed are they of prices, of credit options, of weather forecasts? Our last table attempts to answer some of those questions. The survey asked farmers if they had access to credit, to weather information, and to agricultural prices.

Table 9.29. Type of information available (% of farmers receiving and using information)

	CARE	CRS	REST	SC/US	WVE	Average
Crop price information						
% farmers receiving info	93.7%	94.8%	96.4%	81.9%	93.4%	92.0%
If receivd info, used it?	63.6%	80.4%	93.4%	74.0%		95.7%
Frequency of information						
Daily	7.1%	3.8%	11.1%	23.8%	5.1%	9.9%
Weekly	70.0%	83.7%	76/9%	60.8%	81.8%	74.9%
Bi-monthly	6.0%	1.3%	2.0%	6.5%	5.1%	4.1%
Monthly	8.4%	8.7%	6.6%	7.2%	6.3%	7.5%
Other	8.5%	2.5%	3.4%	8.9%	1.8%	3.7%

[56] This hypothesis receives some support from the fact that only 11.1% of the total grain output was sold in this year (last column in Table above). It is believed that the figure in normal years is closer to 20% (personal communication from Samson Dejene, of the Ethiopian Grain Trade Enterprise).

Table 9.29. Type of information available (% of farmers receiving and using information)						
	CARE	CRS	REST	SC/US	WVE	Average
Source of information						
Radio	2.5%	1.7%	1.3%	4.6%	2.7%	2.5%
Traders	33.3%	34.8%	25.7%	69.3%	67.1%	44.7%
Extensionist	.5%	1.0%	11.0%	.4%	1.5%	3.0%
Neighbors	61.2%	50.4%	61.4%	24.3%	26.6%	46.0%
Other	2.5%	12.2%	.7%	1.4%	2.1%	3.9%
Livestock price information						
% farmers receiving info	90.6%	93.2%	93.8%	81.1%	83.0%	88.6%
If receivd info, used it?	57.67%	72.9%	89.9%	68.8%	73.0%	96.1%
Frequency of information						
Daily	4.5%	2.4%	11.0%	16.8%	4.0%	7.7%
Weekly	71.3%	78.6%	74.0%	59.4%	71.4%	71.3%
Bi-monthly	6.1%	2.8%	2.5%	6.6%	8.7%	5.1%
Monthly	8.1%	12.9%	10.1%	16.4%	13.3%	12.0%
Other	9.9%	3.2%	2.4%	.7%	2.7%	3.9%
Source of information						
Radio	2.0%	.6%	1.1%	4.2%	2.7%	2.0%
Traders	34.0%	36.1%	26.5%	75.4%	60.2%	44.6%
Extensionist	.6%	1.0%	12.0%	.6%	2.3%	3.5%
Neighbors	60.7%	49.3%	59.8%	18.6%	32.6%	45.8%
Other	2.7%	13.0%	.6%	1.1%	2.2%	4.1%

Almost all farmers say they have information on crop (92.0%) and livestock (88.6%) prices. The frequency and source of this information varies but generally, they receive information weekly through traders or neighbors. Radio programs and extensionists account for very little of the crop and livestock data they receive. Although one may find some variation between CSs, those trends are generally the same everywhere.

Chapter Ten: Econometric Analysis of Cereal Yields

The preceding two chapters examined the general performance of agriculture in our sample, and the possible determinants of that performance. In this last chapter of Part III, we examine the relationship between agricultural performance outcomes and their hypothesized determinants using multivariate analysis. More definitive conclusions are offered at the end of this Chapter about the determinants of performance in agriculture.

Empirical Model and Hypotheses

As previously exposed in the introduction to Chapter Eight, we assume that yield of a particular crop on a particular household's plot (y_{hp}) in the survey year is determined by the season (meher or belg) (S); access to technical assistance information through agricultural training or extension programs (TA_h); the household's human capital and experience in cereal production (HC_h), the household's endowments of natural and physical capital (PC_h); the quality and tenure characteristics of the plot (LQ_p); prior land investments made on the plot (LI_p); the use of inputs and land management practices during the current cropping year on the plot (LM_p); and other unobserved factors affecting production (such as weather) that vary across the plots and households in the sample during the survey year (u_{hp}):

$$y_{hp} = f(S, TA_h, HC_h, PC_h, LQ_p, LI_p, LM_p, u_{hp})$$

Access to technical assistance is measured by whether the village has a community-based organization (CBO) focusing on providing agricultural training, and the number of contacts the household had with agricultural extension programs in the prior six years. Access to technical assistance is expected to increase cereal yields.

The household's human capital and experience is measured by the median education of males in the household, the median education of females in the household, the age, gender and primary occupation of the household head (whether cultivation, herding or pastoralism, off-farm employment, unpaid employment such as domestic work, unemployed, ill or disabled). We also include the labor endowment of the household in human capital, measured by the number of household members and the proportion of members that are dependents (less than 15 years of age or more than 70). This is because the survey did not adequately measure family labor input, so family labor endowment is included as a proxy for family labor input. We expect that household's with a larger labor endowment (larger households or smaller share of dependents) may obtain higher yields if labor markets do not function efficiently (but no effect if such markets are efficient). Female-headed households may be less productive as a result of tighter labor and cash constraints, and because of cultural norms prohibiting women from plowing.

Other human capital variables can have more ambiguous impacts. For example, education may increase farmers' awareness of and ability to use new technologies, which will tend to increase productivity. On the other hand, education may increase households' opportunities and interest in off-farm activities, thus tending to reduce family labor and management input and hence crop yields. The effects of male vs. female education on crop yields may be different, as they may have different impacts on these considerations. Older household heads have more experience in

farming and may thus be more productive, but they may also be less productive due to negative effects of age on health. Households whose heads are focused on cereal production as their primary activity may be more productive because of the experience and management effort related to cereal production; but households with more off-farm income may be better able to afford to purchase inputs such as seeds and fertilizer.

The natural and physical assets of the household include the amount of land owned, the number of livestock owned by type (oxen, other cattle, and small ruminants), the value of farm tools and equipment owned, and the value of durable goods owned. We also include whether the household owns a functioning radio, since this affects the household's access to information, which can influence crop productivity. If there are imperfections in land and labor (or other) markets, there may be a negative relationship between the amount of land owned and crop yields, since households with less land may farm using their labor and management skills more intensively (Sen 1966; Carter 1984; Feder 1985). Controlling for land area owned and use of oxen labor per ha., households with more oxen may be able to obtain higher yields because of greater ability to use oxen when they are most critically needed. Greater ownership of farm tools and equipment is also expected to increase yields. Greater ownership of other animals (other cattle and small ruminants) can have ambiguous effects. It may contribute to productivity by providing manure that contributes to soil fertility and/or by increasing the household's financial liquidity and hence its ability to purchase inputs. On the other hand, it may cause the household to devote more of its labor and management effort to caring for livestock and less to crop production, thus potentially reducing crop yields. Ownership of durable goods increases the household's liquidity, and thus may contribute to greater use of inputs and production, unless higher wealth also leads to higher preference for leisure, which may reduce production.

The quality and tenure characteristics of the plot include the size of the plot, how it was acquired (whether acquired by inheritance, gift, allocated by the peasant association (PA), rented, sharecropped or borrowed), whether the plot is a homestead plot or a cultivated field away from the homestead (plots under other land uses such as pasture or fallow were excluded from the analysis), the walking time to the plot from the household's residence, the slope of the plot (flat, gently sloped, steeply sloped, or mixed), the dominant type of soil on the plot (e.g., vertisol, leptosol, etc.), and the altitude of the plot (i.e., whether in the *dega* zone (> 2300 meters above sea level), the *woina dega* zone (1500 – 2300 m.a.s.l.), or the *kolla* and *berha* zones (< 1500 m.a.s.l.)). As a result of past land redistribution practices, smaller plots may tend to be of higher quality, since higher quality land is often subdivided into smaller parcels to be able to distribute it more broadly. Thus yields may be higher on smaller plots. Land quality may also be different on plots of different tenure; for example, gift or borrowed plots may be of lower quality than others, and thus may have lower yields. Sharecropping may lead to lower yields by reducing the tenant's incentive to apply labor and other inputs, since he or she does not reap the full marginal benefits of using inputs, unless the landlord can easily monitor the tenant's effort (Otsuka and Hayami 1988; Shaban 1987). Homestead plots and plots closer to the homestead may be of higher quality because farmers are more prone to apply bulky inputs such as manure and compost to such plots. Greater tenure security and ability to protect against crop theft on such plots may also contribute to higher yields by encouraging greater investment or effort on these plots. Differences in soil types, plot slope and altitude also can lead to differences in yield for

agronomic reasons; though we will not discuss the impacts of such agronomic factors in this Chapter since we wish to focus on the impacts of program or policy-relevant factors.

The most common land investments found in the survey include stone terraces, soil bunds, check dams, drainage ditches, live fences, clearing of stones, leveling the plot, and provision of irrigation. We expect that these investments contribute to higher cereal yields. Other investments, such as tree planting, trenches, and others, were too rare to be used in the econometric analysis.

The inputs and annual land management practices influencing cereal production include the amount of hired wage labor (recall that family labor use was not adequately measured), oxen labor, and seeds, and whether the household used improved seeds, urea diammonium phosphate (DAP) fertilizer, chemical pesticides, burning, manure or green manure on the plot in the survey year. Other land management practices such as mulching and composting were too rare to be used in the analysis. All of these inputs and land management practices, except burning, are expected to contribute to higher yields.

Econometric Approach

Equation (1) is estimated using a linear model, but with natural logarithmic transformations of yields and all continuous explanatory variables. This is consistent with the common Cobb-Douglas production function specification. In addition, the logarithmic transformation makes all of the continuous variables more normally distributed, which reduces problems of nonlinearity and reduces sensitivity of the results to outliers, thus improving the performance of the regression models (Mukherjee, et al. 1998). Coefficients of continuous explanatory variables in a linear log-log specification can be interpreted as response elasticities; i.e., the percentage change in yield resulting from a one percent change in the explanatory variable. For explanatory variables that take zero values, a simple logarithmic transformation is not possible, since the log of zero is undefined. Instead, we use the transformation $\ln(1+x)$ for all such variables, which equals zero when x is zero and increases monotically with x.

Discrete dummy explanatory variables were not transformed in any way. The coefficients of these variables represent the predicted impact of the presence of a particular characteristic on the ratio of yield with and without the characteristic. For example; a coefficient value of 0.5 for plots using improved seeds would mean that yield is predicted to be $e^{0.5}$ or 1.65 times as high when improved seeds are used. For small values of these coefficients (about 0.1 or less), the coefficient value represents the approximate percentage difference in yield resulting from presence of the factor (e.g., a value of 0.05 for presence of a CBO would mean that yields are about 5% higher where a CBO is operating than where one is not).

We estimated equation (1) separately for each of the major cereal crops—maize, wheat, sorghum, teff and barley. For each cereal, we estimated four models: ordinary least squares using all of the explanatory variables (OLS – full model), ordinary least squares excluding household level and land tenure variables that were jointly statistically insignificant in the full model (OLS – short model), instrumental variables estimation of the short model (IV model), and a reduced form model including all of the explanatory variables in equation (1) except inputs

and land management practices (RF model). By comparing results of the OLS, IV and RF models, one can draw more robust conclusions about the factors affecting crop yields than is possible from using only one of these models. The rationale for these different models and tests to select among them are discussed in Annex 2.

In addition to the models using the full sample, we estimated the OLS – full model for each of five socioeconomic regions in which a sufficiently large number of observations was found (Harerghe, Eastern Shewa, Borena and Filtu, South Gonder and Wello, and Tigray). The purpose of this exercise was to determine the extent to which the responses of yield to different factors vary in different environments[57]. In some cases, the resulting sample size was too small for reliable estimation. We report only the results of estimations in which there were at least 100 observations of crop yield for the particular crop in the region being considered.

Results

In this section we present and discuss the estimation results by crop. In the next section, we summarize the main findings across crops.

Maize

The estimation results for maize, using the full sample, are presented in Table 1. Only two factors have statistically significant (at least at the 10% level) impacts across all four specifications: the proportion of dependents in the household and the area of the plot (both negative impacts on yield). These impacts are consistent with our hypotheses. Four factors have statistically significant impacts in all but the IV model: the presence of a CBO providing agricultural training (positive impact), the number of cattle other than oxen (positive), and presence of a check dam on the plot (positive). The impacts of CBO agricultural training programs, cattle and check dams are also consistent with our expectations.

Several inputs and land management practices have significant impacts in both OLS models, but are insignificant in the IV model, including oxen use (positive), seed use (positive), use of burning (negative), and manuring (positive). All of these impacts, except that of burning, are as hypothesized. The negative impact of burning and the positive impacts of oxen use, seeds and manuring are consistent with the results of Pender and Gebremedhin (2003) for the highlands of Tigray. The only input or land management practice found to have a statistically significant impact in the IV model is use of DAP, which has a very large positive impact.[58] However, the magnitude of this impact is not believable, is not found in the OLS regressions, and may be an example of the bias involved in IV estimation (Bound, et al. 1995). Plots received as gifts have higher yields than inherited plots (weakly statistically significant) in the OLS full model and RF model. The number of contacts with agricultural extension has a weakly significant positive impact in the OLS – short model.

[57] Given the importance of agroecological variables on output, it is not useful to break down the analysis by CS as three of the five CSs operate in various agroecological zones.

[58] The coefficient of 3.015 for DAP in the IV model in Table 1 implies that yields are predicted to be about 20 times as large ($e^{3.015} = 20.39$) using DAP than without it.

Our test of overidentifying restrictions indicates that the restrictions used in the IV model are valid, while the relevance tests show that the instrumental variables are relevant predictors of the endogenous explanatory variables.[59] Thus the IV model is supported. Nevertheless, the Hausman test fails to reject the OLS model, which is therefore the preferred model, since it is more efficient than the IV model.

These results suggest that there is potential to substantially increase maize yields in the study areas through investments in agricultural training, check dams and appropriate land management practices, including reduced use of burning and increased use of manure, oxen power and seeds.

In Table 2 we investigate how these results vary across socioeconomic regions. The negative impact of plot size on yield and the positive impact of the amount of seed used is consistent across all three regions in which there were sufficient observations to estimate the model (Harerghe, Borena/Filtu, and Tigray). Check dams have a large positive impact and proportion of dependents a negative impact in both Borena/Filtu and Tigray, while the impact of greater extension contacts is positive in both Harerghe and Borena/Filtu. A significant positive impact of CBO's providing agricultural training was found only in Borena/Filtu. Several other factors were also found to have a statistically significant impact (10% level) only in one region: belg season (lower yield than meher in Harerghe), female household head (positive impact in Harerghe), primary activity in paid off-farm work (negative in Tigray), more female education (negative in Harerghe), oxen owned (positive in Borena/Filtu), other cattle (positive in Harerghe), tools (negative in Borena/Filtu), rented land (positive in Tigray), sharecropped land (negative in Tigray), distance to the plot (positive in Tigray), drainage ditch (positive in Borena/Filtu), leveled plot (positive in Tigray), wage labor use (negative in Harerghe), oxen labor use (positive in Borena/Filtu), DAP use (positive in Harerghe), urea use (positive in Borena/Filtu), chemical pesticide use (positive in Harerghe), burning (negative in Harerghe), and manuring (positive in Borena/Filtu). Most of these results are consistent with our expectations, though a few (e.g., higher yields for female-headed households, negative impact of tools, positive impact of distance to plot) are puzzling. The fact that such puzzling findings occur only in one region and are usually only weakly statistically significant suggests that these may be statistical flukes (which can happen 10% of the time with a 10% significance level), and not too much significance should be ascribed to them.

There are a few examples of factors that have different direction of impacts in different regions, including land owned (positive in Borena/Filtu, negative in Tigray), ownership of a radio (negative in Borena/Filtu, positive in Tigray), and cultivated field (higher yield than homestead plot in Harerghe and Borena/Filtu, lower in Tigray). These findings and those discussed above suggest that the impacts of many factors on yields may be context-dependent.

Wheat

As for maize, the tests of overidentifying restrictions and relevance tests support the IV model for wheat (Table 3). However, we were unable to use the Hausman test results, because the test statistic was negative, indicating a violation of the assumptions of the test. Thus, we cannot select a preferred model based on this test in this case.

[59] See Annex 2 for explanation of the tests conducted.

Several factors have robust impacts on wheat yields in all of the model specifications, including season (lower in belg), CBO providing agricultural training (positive), education of males (negative), tools (positive), plot size (negative), and presence of a stone terrace (negative). All of these are consistent with our expectations, except the negative impact of stone terraces. This finding contradicts findings of two studies conducted in Tigray (Gebremedhin, et al. 1998; Pender and Gebremedhin 2003), and one in Amhara (Benin 2003), all of which found significantly higher yields associated with stone terraces. Perhaps the drought in 2002 contributed to these anomalous results, though we expected that such soil moisture conservation measures would be more effective in avoiding yield losses in a drought. The negative yield impact of terraces could be due to their impacts on reducing cropped area or harboring pests (Herweg 1993), which may outweigh their positive impact, especially when the terraces are relatively new and their benefits in terms of soil and moisture conservation have yet to be realized. For example, Shiferaw and Holden (1998) found in a study in northern Shewa that it generally takes over five years for teff or faba bean yields to increase after establishment of soil conservation structures. Further research, taking into account the age of terraces in the sample, is needed to better understand our results on terraces.

A few factors have significant and consistent impacts in all but the IV model, including off-farm work as the primary activity of the household head (negative impact), and the number of other cattle owned (positive). Some have significant and consistent impacts in two models, including household head ill or disabled (positive impact in both OLS models), land area owned (negative impact in OLS full model and RF model), use of oxen, seed, DAP and pesticide (positive in both OLS models). Some have significant impacts in only one model, including pastoralist/herding as primary occupation (positive in RF model), female education (negative in OLS full model), and use of urea (positive in OLS short model). Most of these results are consistent with our expectations, except the higher yields associated with the household head being ill or involved in pastoralism. We do not have explanations to suggest for these results, which may be statistical anomalies.

Investigation of determinants of wheat yields across regions reveals many differences (Table 4). We find no factor that has consistent and statistically significant impacts in all four of the regions where sufficient observations exist (Harerghe, Borena/Filtu, South Gonder/Wello, and Tigray). Plot area is associated with lower wheat yields in three regions, while greater use of oxen labor is associated with higher yields in three regions. Pastoralists have higher yields in two regions, soil bunds are associated with lower yields in two regions, and urea use is associated with higher yields in two regions. Several other factors have significant impacts in only one region or opposite impacts in different regions.

These findings suggest that wheat yields can be improved by investing in CBOs to provide agricultural training, oxen and other cattle, and provision of seeds, fertilizer and pesticides. However, many of these and other impacts appear to be location specific.

Sorghum

The test of overidentifying restrictions indicates that the instrumental variables used in the IV model for sorghum are valid, and the instruments are relevant in predicting most of the endogenous variables (Table 5). As for wheat, the Hausman test is inconclusive.

The explanatory variables having a consistent and significant impact on sorghum yield in all four models include the presence of a CBO providing agricultural training (positive), age of the household head (positive), male education (negative), value of durables owned (positive), plot area (negative), and rented plots (greater than for inherited plots). Significant and consistent impacts in all but the IV model were found for female household head (positive), pastoralist/herder (positive), and proportion of dependents (negative). Significant and consistent impacts in all but the RF model were found for stone terraces and live fences (negative for both). Significant impacts in two models were found for seasons (lower in belg in OLS short model and IV model), oxen and seed use (positive for both in both OLS models). There are a few cases of variables significant in only one model, including ownership of a radio (positive in RF model), drainage ditch (positive in OLS short model), and burning (negative in OLS short model). Most of these results are consistent with our hypotheses, except the finding of higher yields for female-headed households and for pastoralist/herder households, and lower yields on plots with stone terraces or live fences.

Many of the results differ across the two regions where there were sufficient observations to estimate the models (Harerghe and Tigray) (Table 6). The only factors having significant and consistent impacts in both regions include proportion of dependents (negative), value of tools owned (positive), area of plot (negative), and mixed slope (positive). Several factors have a significant impact in only one region, including extension contacts (negative in Tigray), age of household head (positive in Harerghe), unemployed household head (negative in Tigray), male education (negative in Tigray), household size (positive in Tigray), land area owned (positive in Harerghe), other cattle owned (positive in Harerghe), PA-allocated plot (less than inherited plot in Tigray), rented plot (more than inherited plot in Tigray), soil bunds and check dams (negative in Harerghe), irrigation (negative in Tigray), use of oxen, seed, improved seed and DAP (positive in Harerghe), and use of urea, pesticide, burning and green manure (negative in Tigray). In a few cases, there are opposite effects of factors between the two regions, including the effects of the household head being ill or disabled, female education, oxen owned, and gift land.

Some of these findings are puzzling (e.g., negative effect of extension, irrigation, oxen ownership, and various inputs and land management practices in Tigray, negative impacts of soil bunds and check dams in Harerghe). Pender and Gebremedhin (2003) found statistically insignificant impacts of several of these factors in Tigray on the total value of crop production per ha. (extension, irrigation, oxen ownership), but their results were not nearly as pessimistic as these. Perhaps drought conditions in 2002 rendered many of these investments and practices less beneficial in that year than in 1998 (the year surveyed by Pender and Gebremedhin), especially for sorghum. Some of the puzzling results may be due to the small sample size for sorghum (especially in the Tigray regression), making the results more susceptible to anomalous results.

These findings suggest that several factors can contribute to increased sorghum yields, including development of CBOs providing agricultural training, development of land rental markets, and provision of oxen and seeds. As for other crops, however, the impacts of these and other factors appear to be quite location specific.

Teff

The IV model for teff satisfies the test of overidentifying restrictions, and the instrumental variables are relevant in almost all cases (Table 7). As for maize, the Hausman test does not reject the OLS model, which is therefore the preferred model.

Several explanatory variables have statistically significant and consistent impacts in all four models, including primary occupation in paid off-farm work (negative impact), number of oxen owned (positive impact), tools owned (positive impact), area of the plot (negative impact), and cultivated field away from homestead (lower yield than homestead plot). Walking time to the plot has a significant negative impact in three of the models, while consistent results are found in two models for CBOs providing agricultural training (positive in IV and RF models), pastoralist/herder (negative in OLS full model and RF model), and use of wage labor, oxen labor, improved seed and pesticide (positive in both OLS models). All of these results are consistent with our hypotheses, and indicate that teff is a cash crop that is responsive to input of farmers' management effort, labor, oxen tillage, tools, improved seeds and pesticides. Teff appears to be less responsive to fertilizer use, land investments and other land management practices.

The impacts of most explanatory variables on teff production vary substantially across socioeconomic regions (Table 8). Only one factor—area of the plot—has a statistically significant and consistent impact across all four regions analyzed (Eastern Shewa, Borena/Filtu, South Gonder/Wello, and Tigray), being negatively associated with yields (as for other crops). Some factors have consistent impacts in two of the regions, including land rental (lower yields on rented than inherited plots in Borena/Filtu and Tigray), use of improved seed (positive impact in Eastern Shewa and Tigray) and pesticide (positive impact in Borena/Filtu and Tigray). Several factors have significant impacts in only one region, including number of extension contacts (positive in Eastern Shewa), female household head (positive in Borena/Filtu), occupation as pastoralist (negative in Borena/Filtu), female education (positive in Eastern Shewa), land area owned (negative in Tigray), number of oxen owned (positive in Eastern Shewa), value of tools owned (positive in Tigray), ownership of a radio (negative in Eastern Shewa), inherited land (higher yield than on plots acquired by all other means in Borena/Filtu), cultivated fields (lower yield than on homestead plots in Borena/Filtu), presence of a soil bund (negative in Borena/Filtu), check dam (positive in South Gonder/Wello), or live fence (positive in Borena/Filtu), use of wage labor (positive in Eastern Shewa), oxen labor (positive in Tigray), burning (negative in Borena/Filtu), and manuring (positive in Eastern Shewa). Some factors have opposite impacts in different regions, including proportion of dependents, number of small ruminants owned, plots received as a gift, presence of a drainage ditch, and use of urea. As discussed above for other crops, some of these variations may be due to the relatively small number of observations for some regions; however, there does appear to be significant variation in impacts of some factors across socioeconomic regions.

Barley

The IV model for barley passes the test of overidentifying restrictions, and the instrumental variables are relevant for predicting most of the endogenous explanatory variables (Table 9). The Hausman test fails to reject the OLS model, which is therefore the preferred model.

The factors that significantly affect barley yield in all four models include the head of household having no occupation or being a student (positive), the value of durable goods owned (positive), and the area of the plot (negative). There are significant impacts in all of the models except the IV model for land tenure (lower yields for gift or rented plots than inherited plots), cultivated fields (lower yields than homestead plots), and presence of a soil bund (positive). Use of green manure has significant negative impacts on barley yield in both OLS models and the IV model. Consistent and significant impacts for two of the specifications were found for extension contacts (negative in OLS short model and RF model), paid off-farm employment (negative impact in both OLS models), number of other cattle (positive impact in OLS short model and RF model), land tenure (lower yield on PA-allocated plots than inherited plots in OLS short model and IV model), and use of oxen labor, seed, improved seed, pesticide and manure (positive impacts in both OLS models). Most of these impacts are consistent with our expectations, except the positive impact of the household head being unemployed or a student and the negative impacts of extension and green manure. It appears that barley yields are most sensitive to use of inputs such as oxen tillage, seeds, pesticides and manure, while the extension program focus on promoting inorganic fertilizer appears not to have been successful for barley.

Among the socioeconomic regions in the sample, barley is common only in South Gonder/Wello and Tigray. Only a few factors have significant and consistent impacts on barley yields in both regions, including the area of the plot (negative) and cultivated field (lower yield than homestead plot). Factors that are significantly associated with barley yield in South Gonder/Wello but not Tigray include extension contacts (negative), age of the household head (negative), primary occupation pastoralist or herding (positive), number of oxen owned (negative), sharecropped or borrowed plot (lower yield than inherited plots), walking time to the plot (positive), use of wage labor (negative), pesticide (positive) and burning (negative). Factors associated with barley yield in Tigray but not South Gonder/Wello include female household head (negative), primary occupation in unpaid work or no occupation/student (positive), area of land owned (negative), rented plot (lower yield than inherited plots), soil bund (positive), check dam (positive), live fence (negative), and use of oxen labor, seed, and manuring (positive). Many of these results for Tigray are consistent with results of Pender and Gebremedhin (2003) (e.g., negative impact of female headed household, positive impact of soil and water conservation measures, and oxen, seed and manure use).

These results suggest that investments in appropriate soil and water conservation measures and land management practices, such as use of manure, together with availability of seeds and draft power, may be more effective in promoting increased barley yields than promotion of inorganic fertilizer use in barley production. As with other crops, however, what works will vary by socioeconomic region.

Summary of Findings

The qualitative findings of the econometric analysis are summarized in Table 11. The factors having the most consistent impacts on cereal yields, across all of the main cereal crops, are plot size (negative impact on yield of all cereals), amount of oxen labor and seeds used (positive for four cereals), presence in the community of a CBO providing agricultural training (positive for four cereals), ownership of cattle other than oxen (positive for three cereals), off-farm employment (negative for three cereals), and use of pesticides (positive for three cereals). All of these robust findings are consistent with our hypotheses, and indicate that cereal production in Ethiopia is constrained by land quality (associated with plot size), use of key inputs, farmers' technical knowledge, and cattle ownership. In many cases, constraints on households' labor supply or managerial capacity appear to be important, given the negative impact of off-farm employment, male education and dependency ratio on yields of several cereals. Nevertheless, use of hired labor had a significant impact only for teff, probably because teff is more of a cash crop than the other cereals, which are produced largely for subsistence.

Several other factors affect production of at least two cereals, including ownership of durable goods (positive impact on yields of sorghum and barley), tools (positive impacts on wheat and teff), cultivation on plots away from the homestead (lower yields of teff and barley compared to homestead plots), presence of stone terraces (lower yields of wheat and sorghum) and check dams (higher yields of maize and wheat), use of improved seeds (positive impact on teff and barley yields), DAP (positive impact on maize and wheat yields), burning (negative impact on maize and sorghum yields), and manuring (positive impact on maize and barley yields). With the exception of the negative impact of stone terraces on wheat and sorghum yields, none of these findings is inconsistent with our hypotheses. They suggest the importance of physical asset accumulation to benefit production, at least for some cereals, and some investments and inputs that are useful for some crops. Burning to clear and prepare fields has negative impacts on some crops, as also found by Pender and Gebremedhin (2003), and should be discouraged by technical assistance programs.

Other factors have more limited impacts or, in some cases, opposite impacts depending on the crop. For example, the number of extension contacts is associated with higher maize yields but lower barley yields, perhaps because extension technologies are more suited to maize and hence cause farmers to reduce efforts in barley production where both crops are produced. Pastoralists/herders attain higher yields of wheat and sorghum but lower yields of teff. This may be because pastoral activities can contribute to yields by providing manure (even controlling for the household's own livestock ownership, since others' animals may also graze on a pastoralist's land), but tend to compete with use of livestock to support oxen for tillage, which is most critical for teff. The impacts of land tenure vary across crops; for example with higher sorghum yields but lower barley yields on rented than inherited plots. The reasons for such differential impacts of land tenure on yields of different crops are not clear.

It is notable that irrigation was found to have an insignificant effect on yields of all of the major cereal crops. This does not imply that irrigation has no effect on farmers' incomes in the study regions, since it may be more important for promoting production of higher value crops such as

vegetables, or production during the dry season, neither of which were addressed in this analysis. Traditional irrigation systems are used more for vegetables and fruits than for cereals. But where it was available on cereal plots, we do not find that irrigation contributed substantially to cereal yields in the main cropping seasons in the study region. This may be due in part to limited availability of irrigation water during the main rainy season in 2001/2002 as a result of the drought. This finding is consistent with the findings of Pender and Gebremedhin (2003) for Tigray and Benin (2003) for the western part of the Amhara region. Benin (2003) did find a positive impact of irrigation on crop production in drought-prone areas of eastern Amhara, however.

These findings suggest several potential areas of intervention (and areas of non-intervention) to promote increased cereal production in the study regions. Development of CBOs to provide agricultural training appears to be a promising approach, though more research is needed to better understand how these CBO's are promoting improved agricultural production in the study villages where they are present, and why they are having such positive impacts. The farmer centered participatory approach pursued by most such organizations is probably a key reason for their demonstrated success in promoting increased productivity.

By contrast, the government's more top-down and narrowly focused agricultural extension program appears to have had limited success (except for maize). Broadening of the approach to include other livelihood strategies and technologies beyond the past emphasis on promoting mainly improved cereal varieties and fertilizer appears to be needed (and has begun to be instituted by the Ethiopian government), as is a more farmer-centered approach. Furthermore, even where there is good potential for improved seeds and/or fertilizer, farmers need more crop and location specific information regarding fertilizer and other technology recommendations, access to appropriate types of fertilizer suited to local needs (rather than universal application of DAP and urea), and training in proper methods of using fertilizer and other inputs. Addressing these problems could facilitate more productive and profitable use of fertilizer and other inputs.

Improved land management technologies such as check dams, soil bunds, reduced burning and use of manure offer potential for increased production of some crops in some contexts. Such practices, as well as others such as irrigation, water harvesting, and stone terraces may be complementary to use of fertilizer, improved seeds and other inputs. However, these synergies have not been adequately studied. It is critical that research and technical assistance programs attempt to understand and exploit such potential synergies and recognize the location and crop-dependence of the technologies and land management approaches being promoted. Top-down, "one-size-fits-all" approaches to technical assistance do not work well in the diverse circumstances of Ethiopia.

Our findings appear less promising regarding the impacts of most land investments, but particularly stone terraces and irrigation, both of which are widely promoted in drought prone areas of Ethiopia. As mentioned previously, our findings on stone terraces are in contrast to those of other studies of their impacts, while the findings of other studies on the impacts of irrigation are mixed. These findings suggest that strong positive impacts of such investments is not a foregone conclusion, but should not be taken as proving that they cannot or do not have

positive impacts. More focused research on the costs and impacts of such investments, under different biophysical and socioeconomic environments, is needed to draw definitive conclusions.

The importance of oxen draft power in cereal production, together with the limited impact of oxen ownership on yields, suggests that oxen lease and sharing arrangements and/or land rental and sharing arrangements work fairly well to overcome shortages of oxen draft power relative to the farmer's operated land area. Pender and Fafchamps (2001) and Ahmed, et al. (2002) found a similar result in research conducted in the Arsi region.

Despite the large amount of rhetoric on the land tenure issue in Ethiopia, our results (and other studies) suggest that the issue may be overblown, at least as regards factors affecting cereal production. We do not find strong and consistent impacts of different land tenure arrangements on cereal yields. This is consistent with the findings of Pender and Gebremedhin (2003) and Benin (2003). Other issues appear to be more critical to increasing cereal production in Ethiopia.

Our findings suggest that liquidity constraints may be binding for Ethiopian farmers, affecting their ability to purchase cattle, inputs and tools. Development of micro-finance savings and credit institutions can help farmers to overcome such constraints. One particular need is longer-term credit, as it is difficult for farmers to repay loans for large items such as a cow within one year, which is the usual limit on loan duration. It is also important to emphasize the potentially vital role of offering farmers profitable and secure financial savings opportunities. Most Ethiopian farmers use livestock as their main form of savings, which can be very risky in drought-prone environments, since livestock often die or lose much of their value during and after droughts.

Our findings suggest that increasing opportunities for education and off-farm employment, while critical for addressing poverty, may cause trade-offs in terms of reduced production of cereals and other crops. This does not mean that such opportunities should not be promoted and pursued. The goal is to reduce poverty and food insecurity, and not simply to increase cereal crop production, and the longer term potential for achieving this goal certainly requires continued improvement in education and off-farm employment. Nevertheless, recognition of the potential negative impacts that progress in these areas can have on agricultural production in the near term can contribute to effective efforts to address the constraints and opportunities arising from this. In cereal deficit areas, the demand for food imports is likely to continue to increase and shift towards more income elastic commodities such as livestock products, vegetables, etc. as education and off farm development increase incomes and reduce food production further. This will increase opportunities for programs to promote production and marketing of such commodities, both in cereal surplus and cereal deficit areas. Cereal surplus areas will find opportunities to produce feed supplies for growing livestock industries (e.g., dairy and livestock) as the demand develops, provided that investments in education and off-farm development continue to improve both rural and urban incomes. The efforts of non-governmental private voluntary organizations can be critical in helping to promote continuing development in this direction.

PART IV

MATERNAL AND CHILD HEALTH AND NUTRITION

Introduction

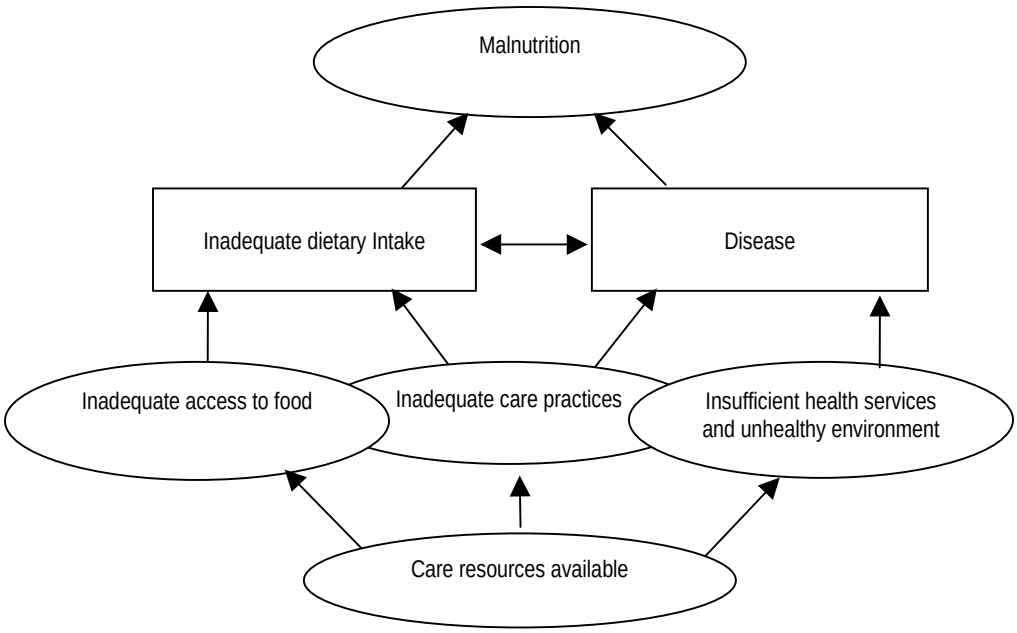
The outcome of interest in this Section is the nutritional status of children. To address the topic, a general description of children's nutrition and health status in the Title II area in Ethiopia is provided and practices potentially influencing the outcome of child malnutrition are discussed. The Section is divided into five related chapters. In Chapter Eleven, the nutritional status of children is presented and age related trends are explored, as indicated by rates of stunting, underweight, and wasting[60]. The subsequent chapters address the behaviors and conditions hypothesized to be related to child malnutrition. The main topics described are: infant and child feeding (Chapter Twelve), the health of the child (Chapter Thirteen), the care provided by the caregiver (Chapter Fourteen), and neonatal and maternal health practices (Chapter Fifteen).

The hypotheses we will be testing to explain children's nutritional status are informed by the UNICEF conceptual framework of the causes of child malnutrition (UNICEF 1990) (figure 11.1). The framework identifies three underlying causes of malnutrition: 1) Inadequate access to food, 2) Inadequate environment, including poor water and sanitation and insufficient health services, and 3) Inadequate care. The presence of any of these conditions is associated with inadequate dietary intake and increased vulnerability to infection and disease, the immediate causes of malnutrition[61].

As suggested by the framework, we hypothesize an interactive relationship between inadequate dietary intake and the presence of infection and disease. The presence of disease leads to poor nutrient utilization, which eventually causes nutrient deficiency or depletion. Similarly, inadequate dietary intake does not provide sufficient nutrients for protection from disease. The interaction is such that insufficient dietary intake, poor nutrient utilization, and/or frequent episodes of infection and disease are direct causes of malnutrition.

[60] The indicators of stunting, wasting, and underweight are based on deficits (<-2 standard deviations than the median NCHS/WHO index value for a child of the same age and sex) in length/height-for-age, weight-for height; and weight-for-age, respectively. A more complete description of each of these indicators is provided in the text of Chapter 11.

[61] While the inter-generational causes of malnutrition are also recognized as important determinants of children's nutritional status, lack of data precludes the relationship between maternal nutritional status during pregnancy and current children's nutritional status from being explored in this report.



Source: UNICEF 1990

Figure 11.1. Conceptual model of malnutrition

Using this conceptual framework, we explore the factors affecting child nutrition in the Title II area in Ethiopia. Data on a variety of characteristics related to child feeding, the child's environment, and care practices are presented. Neonatal and delivery conditions are also examined. Each Chapter in this Section proceeds similarly: we first present univariate statistics of the outcomes and main effects, then analyze the bivariate relationship between the outcomes and those main effects. These associations are then tested again using multivariate methods. The multivariate analysis is presented in Chapter Sixteen at the end of this Section.

Chapter Eleven. Child Nutritional Status

Malnutrition exacts a heavy burden on individuals and on society, through its effect on diminished child health and increased mortality, and by its long-term negative consequences on socio-economic development. The presence of malnutrition means higher rates of illness, disease, and increased risk for mortality. Malnutrition accounts for more than 50 percent of child mortality and around 20 percent of childhood illness and disease in developing countries (Pelletier et al. 1994). Irreversible outcomes of impaired growth and development are also possible, and impose far-reaching consequences. These are related both to the ultimate growth and cognitive capacity of the child as well as to the overall socioeconomic growth and development of a community (Brown and Pollitt 1996).

Improved child nutrition is a key outcome targeted by Title II programs. In this Chapter, we examine the situation in the CS intervention areas with regards to three main nutritional indicators—stunting, wasting, and underweight. Those are the indicators most commonly used to describe the extent of malnutrition in a population[62]. Each of these nutritional indicators provides different information about the prevalence of malnutrition in the population.

Stunting is a reflection of low height-for-age (for children ≥ 2 years) or low length-for-age (children < 2 years), and is an indication of past growth failure. Stunting may be caused by a slowing in the growth of the fetus, resulting in a failure to achieve expected length as compared to healthy, well nourished children of the same age. Stunting is also associated with a number of long-term indicators, including chronic insufficient protein and energy intake, frequent infection, sustained inappropriate feeding practices and poverty. In children over 2 years of age, the developmental and cognitive effects resulting from these repeated, long term factors may not be reversible (Cogill 2003).

Wasting is a reflection of low weight-for-height (for children ≥ 2 years) or low weight-for-length (children < 2 years), and is indicative of current or acute malnutrition. As an indicator of nutritional status, wasting provides information related to short-term nutritional effects, such as seasonal changes in food supply or recent nutritional stress brought about by illness or infection (Cogill 2003).

Underweight is a reflection of low weight-for-age, meaning that a child's weight is significantly lower than expected for a child of the same age. This is less specific than height-for-age or weight-for-height, since a child may be low weight-for-age due to being short, to being thin, or to a combination of both. In other words, low weight-for-age does not differentiate between past and/or current undernutrition. (Cogill, 2003).

Evidence on growth patterns of children throughout the world suggests that children less than five years of age are most appropriate as a reference group when studying malnutrition.

[62] Anthropometric indicators are presented either using prevalence rates, or levels of malnutrition for a population. Both are computed using Z scores. Z scores measure the standardized deviation of a particular child from the pattern of normal growth as expressed by the NCHS/WHO standards. When presenting prevalence rates (which we refer to as stunting, wasting or underweight) the figure is the percent of the population of children in a certain age group that fall below the –2 Z score cutoff, unless indicated otherwise. The level of malnutrition, on the other hand, is the mean Z score for all children of that age group in that population.

Research has shown that well-nourished and healthy children throughout the world demonstrate the same growth patterns (weight and height) as children from industrialized countries, irrespective of race or ethnicity, up until about 10 years of age. The NCHS/WHO reference standards are available for international comparisons of the growth pattern of children, and are recognized as the most accurate standard for international comparison of growth patterns available currently. Application of the NCHS/WHO reference standards to sample specific data allows for anthropometric data to be standardized and comparable globally (Cogill, 2003).

Nutritional Status of Children in the Title II Area in Ethiopia

Data on height-for-age, weight-for-height, and weight-for-age were collected in the Ethiopia Title II Joint PVO baseline survey. The data were collected for children between the ages of 0-6 months and 6-60 months. It should be noted, however, that the data for children of these two age groups were collected according to different sampling methodologies. The data for children 6-60 months were collected by a random sampling methodology whereas the data for children 0-6 months were collected by a convenience sample methodology[63].

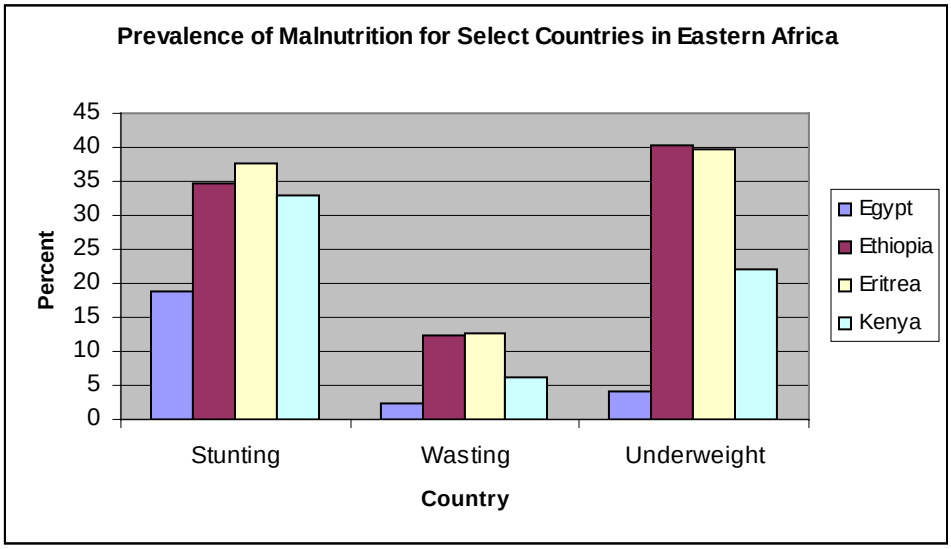
Data on height-for-age, weight-for-height, and weight-for-age of children in the Title II area are discussed below. In general, the Title II Baseline data show high levels of malnutrition. The average prevalence of stunting, wasting, and underweight for children 6-60 months[64] is 34.6, 12.4, and 40.4 percent, respectively (table 11.1), with boys indicated to be slightly worse off than girls. These high rates of malnutrition suggest an urgent need for well-designed program interventions with nutrition-relevant actions. Compared to other countries in the region, the extent of malnutrition in Ethiopia is indicated nearly as high or higher for every country and all indicators (figure 11.2)[65].

[63] The type of sampling approach used should inform the interpretation of the findings presented in this report. Whereas the sample of children 6-60 months allows for statistically representative inferences about the Title II Program area, the convenience sampling approach (used for children 0-6 months) does not allow the same conclusions to be made about the surveyed area. Data related to children 0-6 months should be interpreted as illustrative, but not as statistically representative of the Title II Program area.

[64] Throughout this section, a consistent notation will be used to describe the age grouping of children. The method applied does not include children of the upper bound in the age group. Age groups described as 6-9 months, for example, include children aged 6 through 8.99 months. Children up to 8.99 months are included in the grouping, whereas children 9 months of age are included in the subsequent age grouping.

[65] An important caveat must be made here with regards to the precision of the anthropometric data. We believe that the Joint Baseline Survey data is generally good, but some values were surprisingly low. Stunting rates in the SC/US area for instance, were 11% for children 6-60months, which seemed incongruous given other surveys' indications that rates around 30% are more likely. The authors investigated this issue and found that there may be some error associated with the age data: for instance, "heaping" appears to have happened around key age points (12, 24, 36, 48, 60mo); this may be due also to the conversion from the Ethiopian to the Gregorian calendar, which may confuse mothers and enumerators alike, introducing noise in the age data. However, even when using only data for children on whom we had reliable age data (from their child health card) our stunting data remained unusually low in the SC/US area. We are thus left with two possible explanations for this perplexing finding: either our data represents the true rates, and adjustments have to be made to our perception of malnutrition in that area; or else, the sample may have failed us, which can always happen--there is always a 5 or 10 percent chance that the sample will not be representative of the population.

Figure 11.2



As shown in table 11.1, the prevalence of malnutrition in Ethiopia varies by age group. For each of the anthropometric indicators shown, the rate of malnutrition appears relatively low for the youngest age groups of children. Among children 6 to 9 months of age, the prevalence of stunting and underweight are 12.6 percent and 15.0 percent, respectively, and the prevalence of wasting is less than 6 percent. Among older children, malnutrition is much more prevalent. Among children 30-36 months, for example, the prevalence of stunting and underweight approximate fifty percent, and among children 9-24 months, the wasting prevalence is above percent, a trigger prevalence often used to indicate the presence of a critical or emergency nutritional situation (WHO 2000)[66].

The relationship shown between age of child and the prevalence of stunting is as we would expect. Because stunting is the result of long-term effects from chronic malnutrition, the cumulative increase (from 12.6 percent among children 6-9 months to 44.6 percent among children 21-24 months) is not surprising. The extent of the increase (by 32.0 percentage points over 18 months) is, however, very steep, and evidence of the frequency with which the associated long-term consequences of chronic malnutrition occur in Ethiopia.

[66] The trigger prevalence, as defined by the World Health Organization is ≥15% wasting among children in the full, statistically representative sample is indicative of a critical malnutrition situation. It should be noted that in the Ethiopia Joint Baseline Survey, the wasting prevalence of ≥ 15% applies only to children 9-24 months of age. Among children in the full, statistically representative sample, 12.4% of children were indicated to have weight-for-height Z scores <-2 standard deviations of the NCHS/WHO median for children of the same sex and height.

Table 11.1 Stunting, Wasting, and Underweight[67] among Children 6-60 Months

Age of Child	Stunted	Wasted	Underweight
	(% < -2)	(% < -2)	(% < -2)
0-6 months[68]	5.8	3.7	5.0
6-9 months	12.6	5.4	15.0
9-12 months	23.0	16.1	37.9
12-15 months	29.9	20.6	49.8
15-18 months	37.3	14.1	41.2
18-21 months	38.4	16.6	42.5
21-24 months	44.6	16.4	40.9
24-27 months	30.9	12.2	46.3
27-30 months	38.7	11.2	46.5
30-33 months	38.7	8.7	49.1
33-36 months	51.3	8.5	47.5
36-60 months	37.5	9.4	35.6
Summary statistics by gender			
Boys 6-24 months	33.1	15.8	39.7
Girls 6-24 months	28.8	14.8	38.0
Boys 24-60 months	36.2	10.0	39.5
Girls 24-60 months	38.8	10.1	43.9
Boys 6-60 months	34.9	12.5	39.6
Girls 6-60 months	34.3	12.2	41.3
Total			
6-60 months	34.6	12.4	40.4

While low weight-for-age is fairly uncommon among children 0-6 and 6-9 months (5.0 percent and 15.0 percent, respectively), the proportion of underweight children is much higher among older children. Malnutrition rates increase from 15.0 percent to 37.9 percent for children 9-12 months, followed by an additional increase of 11.9 percentage points for children 12-15 months. This rise in prevalence, however, continues only up until 12-15 months, at which time underweight rates remain relatively constant up through three years of age (ranging from 40.9 to 49.1 percent between the specified age groupings). Wasting rates also follow an age-specific pattern, characterized by a fairly consistent rise in prevalence that corresponds with increasing age of child, up until 24 months when it reaches a plateau, above 15 percent. Beyond 24 months, the rate of wasting decreases.

[67] Prevalence of stunting, wasting, and underweight have been tabulated by comparison of the Ethiopia anthropometric data with the U.S. National Center for Health Statistics/World Health Organization (NCHS/WHO) international reference standards. For the prevalence tabulations shown above, moderately malnourished has been defined as <-2 standard deviations (sd) below the respective median NCHS/WHO height for age, weight for height, and weight for age Z score. The percent of children moderately malnourished (i.e. <-2 sd) include those children severely malnourished (i.e. <-3 sd).

[68] Data collected for children 0-6 months were collected by a convenience sample methodology and are therefore not statistically representative of children 0-6 months in the Title II program area.

As described earlier, the survey data were collected during May-August 2003, at a time when Ethiopia was suffering the shocks of a persistent drought. While the high prevalence of wasting among children 9-24 months can be linked at least, in part, to the 2003 drought, the role of childhood illness, inadequate feeding and caregiver practices should also be considered. From the data in table 11.1, we can already remark, for example, that the highest rates of wasting are among children of complementary feeding age. The elevated levels of malnutrition among this age group could be influenced by inadequate breastfeeding or poor complementary feeding practices. Additionally, poor sanitation and hygiene practices are often more common during a drought period and can increase the frequency with which episodes of childhood infection and diarrhea occur, thereby placing children's nutritional status at risk. The association between child malnutrition and each of these factors will be explored in later chapters.

Table 11.2 presents data on the percent of children severely malnourished[69]. High rates of severe malnutrition are shown for each of the three indicators. The data on stunting show that chronic malnutrition is not only evident in Ethiopia, but is severe in about one out of every three cases. An 18 percentage point increase in severe stunting is shown across age groups; the highest prevalence occurs among children 33-36 months, at 19.7 percent. The data on underweight show a similar pattern, with roughly one out of every four cases of underweight indicated as severe in nature.

Table 11.2. Severe Stunting, Wasting, and Underweight, Children 6-60 Months

Age of Child	Severely Stunted	Severely Wasted	Severely Underweight
	(%<-3)	(%<-3)	(%<-3)
0-6	1.8	0.0	1.1
6-9	3.0	0.6	3.0
9-12	5.2	0.6	9.8
12-15	8.6	1.2	14.6
15-18	12.4	0.6	9.4
18-21	9.6	2.5	9.5
21-24	18.5	1.9	10.1
24-27	12.1	1.0	14.7
27-30	14.1	0.7	11.1
30-33	15.0	0.6	11.0
33-36	19.7	0.8	14.4
36-60	13.9	1.6	4.9
Summary statistics by gender			
Boys 6-24 months	9.8	1.5	11.5
Girls 6-24 months	9.0	1.1	8.1
Boys 24-60 months	13.4	1.4	9.7
Girls 24-60 months	15.0	1.0	8.7

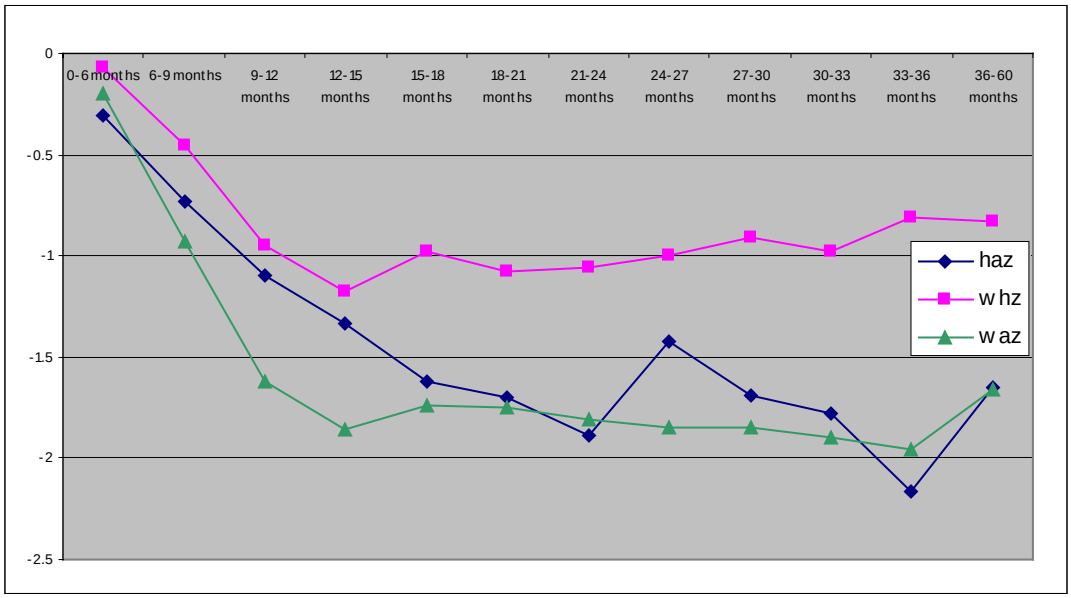
[69] For the prevalence tabulations shown above, severely malnourished has been defined as <-3 standard deviations below the median NCHS/WHO height-for-age, weight-for-height, and weight-for-age Z score.

Age of Child	Severely Stunted	Severely Wasted	Severely Underweight
Boys 6-60 months	11.8	1.4	10.5
Girls 6-60 months	12.3	1.0	8.4
Total			
6-60 months	12.1	1.2	9.4

Across all age groups of children, the rate of severe wasting is shown as ranging from 0.6 to 2.5 percent. These rates are high, and provide further indication of the impact of persistent drought in the Title II program area. Moreover, the prevalence of severe wasting suggests that mortality rates may be elevated in the survey area. Virtually no cases of severe wasting would be expected in a normal situation (Mason 2002).

The pattern of malnutrition across age groups for mean height-for-age, weight-for-height, and weight-for-age Z scores reflects the trends already described by the corresponding prevalence data. In figure 11.3, a rapid decline in nutritional status is shown with increasing age of child for each anthropometric indicator. The decline in nutritional status is most steep during a child's first two years. For weight-for-age and weight-for-height data, the decline in nutritional status is most evident from 0 to 15 months, after which the extent of malnutrition appears relatively constant. For height-for-age data, the cumulative assaults of illness and under/mal-nutrition are evident throughout the full first two years of a child's life, with a mean height-for-age Z score indicated at -0.31 for children 0-6 months and deteriorating to as low as -1.89 for children 21-24 months.

Figure 11.3 Mean Height for Age, Weight for Height, and Weight for Age Z Scores among Children 6 Months to Five Years in Ethiopia



Key Findings & Program Implications

Taken together, these anthropometric data provide critical information about the nutritional status of children in the Title II area at the time of data collection. The high rates of moderate and severe wasting indicate that a serious (if not emergency) situation was present in the Title II Program area during May-August 2003, and that mortality rates were likely also elevated at that time (Mason 2002). The high percent of children with weight-for-height Z scores <-2 and <-3 indicate the need for recuperative and therapeutic feeding programs in the Title II Program area. In addition, chronic malnutrition is highly prevalent in the Program area. The data show high rates of moderate and severe stunting, the impact of which is evident by the time children reach two years of age. These data imply that the greatest impact of interventions aimed at preventing malnutrition may be obtained by targeting children under 24 months of age and caregiver practices related to children of this age.

Chapter Twelve. Infant and Child Feeding Practices

Appropriate infant and child feeding practices are essential to the health and nutritional status of children. The provision of adequate energy and nutrients in a child's diet allows for proper growth and development. Moreover, children fed appropriately are equipped with the strongest possible defense against infection and disease. In the absence of appropriate feeding practices, inadequate energy, protein, and micronutrient intake are likely to result. As discussed earlier, this, in turn, increases vulnerability to disease and infection, potentially impairing the normal growth and development of the child, and heightening the risk for mortality.

In order to provide a framework for the Ethiopia data on the infant and child feeding practices, a selection of the recently issued PAHO/WHO guidelines, along with other internationally established principles for infant and child feeding, are summarized here[70]. Current international guidelines for infant and child feeding recommend that children should be exclusively breastfed from birth up until six months of age. Breastfeeding should be initiated within one hour of delivery and nutrient-rich colostrum should be fed to the infant. Beyond six months of age and through two years or older, the infant should continue to be breastfed frequently, and on-demand. Good hygiene and proper food handling techniques, including avoiding the use of feeding bottles, should be practiced. Starting at six months, complementary foods, in addition to breast milk, should be provided. In general, the number of daily complementary feeds and quantity of food provided at each feed should increase with the age of the child. For the average healthy breastfed infant, meals of complementary foods should be provided two to three times per day for children 6-9 months of age and three to four times per day for children 9-12 months and 12-24 months. In addition, nutritious snacks should be offered to children 6-24 months one to two times per day, as desired.[71] Once complementary feeding is initiated, adequate food group variety is important to ensure that the child's minimum nutrient requirements are met. The nutrient content of complementary foods should be high for all age groups. Meat, poultry, fish or eggs should be eaten daily, or as often as possible. Vitamin A rich fruit and vegetables should be eaten daily, and adequate lipid content should be included in the child's diet. (PAHO/WHO 2003, LINKAGES 2002).

The Ethiopia Title II data on infant and child feeding are analyzed in the context of these guidelines. Key findings from the Title II baseline data are reviewed below, with comparisons drawn between infant and child feeding practices in Ethiopia and current international feeding recommendations.

Exclusive Breastfeeding. Exclusive breastfeeding for children 0-6 months means that from birth until six months of age, the child should receive breast milk only; no other liquids or foods should be fed to the child. During the first six months of life, breast milk meets all of the child's

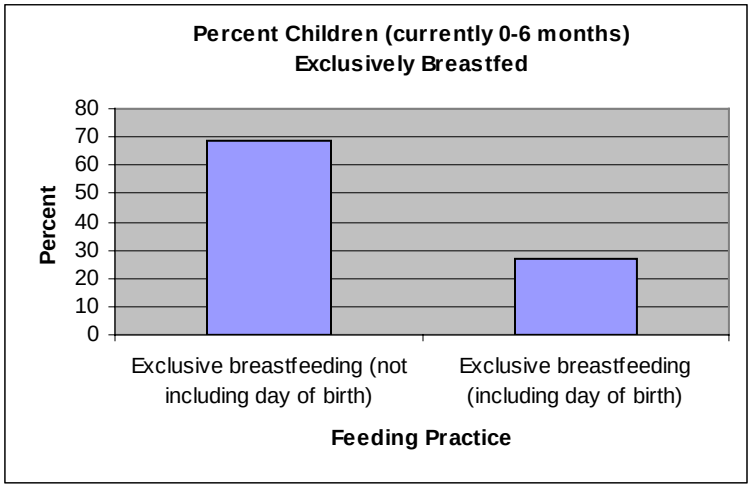
[70] The guidelines presented have been adapted so that they represent a selection of current infant and child feeding recommendations, compiled from a variety of sources, including PAHO/WHO (2003), "Guiding Principles for Complementary Feeding of the Breastfed Child" and LINKAGES (2002), "Facts for Feeding." The guidelines described here are not comprehensive; instead, the guidelines presented are limited to those for which data from the Ethiopia Title II Baseline Survey are available.

[71] The PAHO/WHO document, "Guiding Principles for Complementary Feeding of the Breastfed Child," defines 'snacks' as: "Foods eaten between meals-usually self-fed, convenient and easy to prepare" (PAHO/WHO 2003).

protein, nutrient, and energy needs. In addition, breast milk provides important anti-infective properties to help protect the child against infection.

Exclusive breastfeeding is not uncommon in Ethiopia[72]. As shown in figure 12.1, around seventy percent of children 0-6 months receive breast milk exclusively. This value for exclusive breastfeeding does not, however, take into account feeding practices on the day of birth which are often subject to traditional beliefs. Not all mothers, for example, begin breastfeeding on the day of birth (52.0%). Moreover, many mothers report providing milk other than breast milk on the day of birth (14.1%). In addition, water (sweet - 17.8% and/or plain – 15.8%) is sometimes given to the infant shortly after birth. This can occur as early (or only) on the actual day of birth. Other incorrect feeding practices shown to exist in the survey area include providing butter (8.2%), boiled water (3.6%), and tea (1.0%) on the day of birth[73]. Provision of these liquids and/or foods other than breast milk is detrimental to the health of the infant during the first six months of life. Water and tea, for example, are poor in nutrient content and can expose the child to harmful microorganisms, thereby increasing the child's risk for infection and diseases. Taking into account each of these inappropriate feeding practices on the day of birth, the percent of children receiving exclusive breastfeeding is reduced to 27 percent for children 0-6 months (figure 12.1)[74].

Figure 12.1



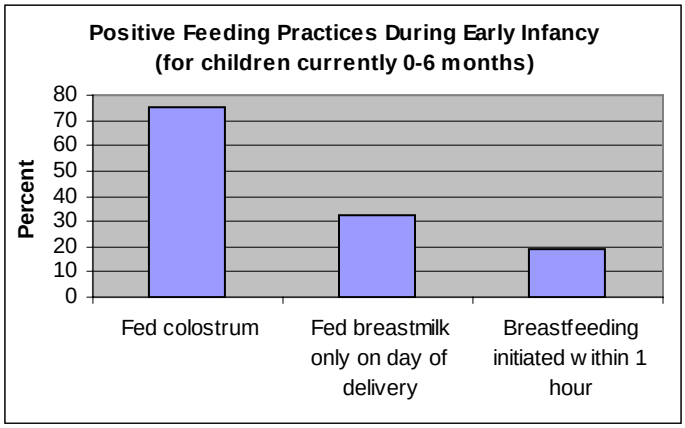
[72] The rate for exclusive breastfeeding was derived by asking the mother about the dietary intake of the child up until time of data collection. Only households having a child currently between the ages of 0-6 months are included in the tabulations for exclusive breastfeeding. Data for children older than six months were not included in these analyses, due to the increased potential for recall bias.

[73] In addition, 12.5% of mothers reported giving something "other" than breast milk to the child on the day of delivery and 0.7% of mothers reported giving "nothing".

[74] Note that the values presented here are derived by a different tabulation method than employed by the Demographic and Health Surveys and that the rate shown here does not represent "Rate of Exclusive Breastfeeding." As described earlier, the values presented here have been calculated from data on children currently between the ages of 0 and 6 months. The values represent the percent of these children that have not yet received any of the following liquids/food items: 1) liquids such as tea or sugar water, 2) milk or cheese, 3) semi-solids, 4) solids, 5) meat or fish, 6) eggs, 7) fruit and vegetables, and 8) oil. The Demnographic Health Survey, on the other hand, tabulates exclusive breastfeeding based on 24 hour recall whereas the rate of Exclusive Breastfeeding would be calculated retrospectively, by asking mothers of children ≥ 6 months the time at which each of these liquid and food items was introduced.

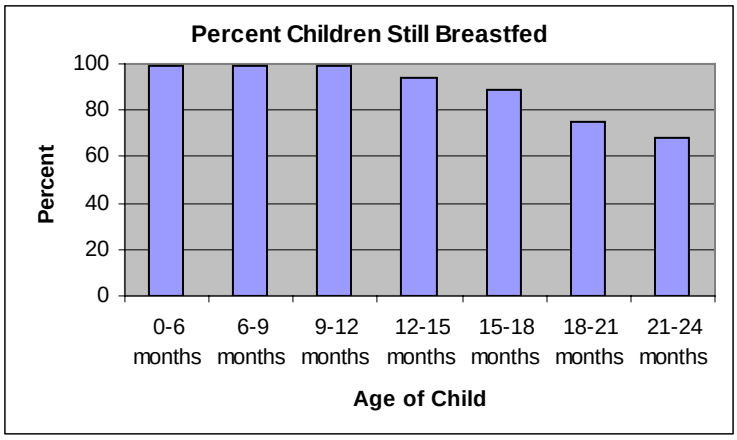
Feeding Practices During Early Infancy. Certain positive feeding practices are more common. For example, three quarters of mothers in Ethiopia report feeding nutrient-rich colostrum to their child. Only one in three mothers, however, initiate exclusive breastfeeding on the day of delivery. Moreover, the initiation of breastfeeding remains unfavorably delayed; less than one in five mothers initiate breastfeeding within the recommended one hour of delivery (figure 12.2).

Figure 12.2



Continued Breastfeeding. Breastfeeding, on the other hand, is a widespread practice in the Title II area. Nearly all children receive breast milk for the full first year, and nearly 70 percent of children receive breast milk until the recommended 24 months (figure 12.3).

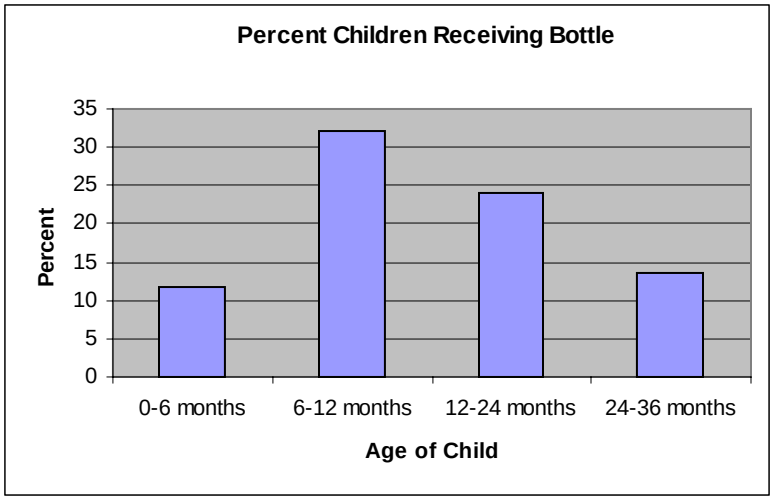
Figure 12.3



The Use of Bottles. Due to the increased risk of infecting the child with harmful bacteria and/or micro-organisms, bottle use is regarded as a negative feeding practice in developing countries. The use of bottles, however, is frequent in Ethiopia (figure 12.4). Nearly one in three children between the ages of 6-12 and one out in four children between the ages of 12-24 months were reported to receive a bottle. Compared to data on bottle use in other countries, these rates are

high. Cooperating Sponsors should continue to discourage the use of bottles for infant and child feeding.

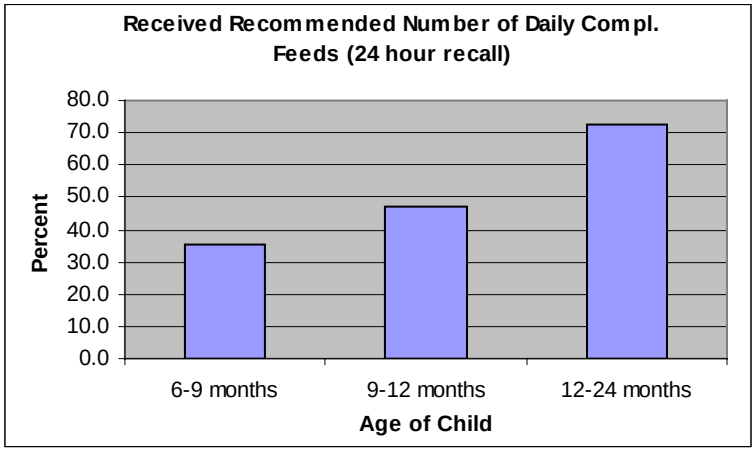
Figure 12.4



Complementary Feeding Frequency. At six months of age, complementary feeding should be initiated. Good complementary feeding[75] involves continued breastfeeding, appropriate frequency of feeding, and adequate nutritional quality of complementary feeds. With regard to frequency, children 6 to 9 months should receive two to three complementary meals and one to two snacks, as desired. Children 9-12 months and 12-24 months should receive three to four complementary meals and one to two snacks, as desired. These recommendations are for children receiving breast milk. Guidelines on frequency of feeding have not yet been established for those children not receiving breast milk. For tabulation purposes, only those children still receiving breast milk are therefore included in the complementary feeding frequency analysis[76] [77]. For the analysis below, the recommended minimum number of complementary feedings per day has been tabulated according to the guidelines, so that children 6-9 months should receive a minimum of two complementary feeds and children 9-12 months and 12-24 months should receive a minimum of three complementary feeds daily[78].

[75] By complementary feeding, we are here referring specifically to the provision of semi solid and solid foods.
[76] The percent of children in each age group that were excluded from the frequency of feeding analysis are: 0.6 percent (1 child) of the 6-9 month sample, 1.2 percent (2 children) of the 9-12 month sample, and 17.3 percent (131 children) of the 12-24 month sample.
[77] Although recommendations on feeding frequency do not exist for non-breastfed children between the ages of 6-24 months, it is important, nevertheless, to understand the frequency of feeding provided to these children. The one non-breastfed children in the 6-9 month sample received four feedings in the last 24 hours. Among non-breastfed children in the 9-12 month sample, all of the children were reported to receive three feeds in the last 24 hours (1 child did not have data on frequency of feeds received). Among the non-breastfed children in the 12-24 months sample, 4.2 percent of children were reported to receive 0 feeds in the last 24 hours, 1.7 percent were reported to receive one feed, 16.8 percent to receive two feeds, 26.1 percent to receive three feeds, and 51.2 percent were reported to receive four or more feeds in the last 24 hours. As already stated, these findings cannot be placed in the context of a feeding recommendation.
[78] The provision of snacks are not included in the tabulations for meeting the recommended feeding frequency. The Ethiopia Title II Joint Baseline Survey did not collect data on the provision of snacks, due to concern from local health and nutrition specialists that the meaning of a "snack" would be misunderstood by the caregivers.

Figure 12.5



As shown in Figure 12.5, the frequency of complementary feeding is insufficient for all age groups of children in Ethiopia. Few children receive the recommended minimum number of semi solid or solid feeds per day. Inadequate feeding frequency is reported for all age groups, but appears most problematic for younger children. Roughly one in three children between the ages of 6-9 months receive the recommended minimum of two daily complementary feeds and less than half of children between the ages of 9-12 months receive the recommended minimum of three daily complementary feeds. Among the oldest age group of children, the percent receiving the recommended minimum of three daily complementary feeds increases to about 70 percent.

Of particular concern is the percent of children in each age group who are reported to have received 0 semi solid or solid foods during the previous day (table 12.1). The high percent of children receiving 0 complementary feeds could indicate a problem related to delayed initiation of complementary feeding, or may be indicative of a lack of food (other than breast milk) being provided to these children with daily regularity. It may also relate to inappropriate feeding practices during child illness (see Chapter 13).

Table 12.1. Frequency of Daily Complementary Feeds by Age of Child

	Number of Complementary Feeds (24 hour recall)				
Age of Child (months)	0 (%)	1 (%)	2 (%)	3 (%)	4 or more (%)
6-9	62.8	2.1	9.7	5.5	20.0
9-12	38.5	5.8	8.3	9.0	38.4
12-24	12.7	4.9	9.8	17.6	55.2
Total					
6-24	25.9	4.6	9.5	14.0	46.0

Dietary Diversity. With regard to the quality of the diets provided, the Title II Baseline survey collected data on the types of foods provided to children 6-60 months in the twenty-four hours prior to data collection. Questions on thirteen different food categories were asked[79]: 1) cereals;

[79] These food categories are a summary of the types of foods asked about in the thirteen related questions. The questions are, as worded in the questionnaire: 1) cereals such as maize, teff, sorghum, and rice 2) nuts or pulses 3) yellow or red vegetable and

2) nuts or pulses; 3) yellow or red vegetable and fruit; 4) starches; 5) beans; 6) garden vegetables; 7) mangos or papayas; 8) other fruit, such as orange, grapefruit, fig; 9) red or white meat; 10) fish or seafood; 11) eggs; 12) food prepared with milk and 13) food prepared with fat, oil, or butter. These thirteen food categories provide some general information on the quality of feeds provided to children[80].

When interpreting data on dietary intake, the seasonal timing of the survey should be taken into account. Data collection for the Ethiopia Title II Baseline Survey occurred between May and August, 2003, at the beginning of what would normally be the wet season in Ethiopia, when fruits and vitamin A rich foods begin to be more available. However, as mentioned earlier, the period of data collection for the Ethiopia Title II Baseline Survey coincided with a period of persistent drought in the country. These factors should be considered when interpreting the data. It is also important that the final evaluation data be collected during the same time of year, in order to ensure that results are comparable.

Figures 12.6-12.9 show the data on food group categories received by children of age specific groups. The respective figures show the percent of children 6-9, 9-12, 12-24, and 24-60 months receiving each of the thirteen food categories on the day prior to data collection. It should be noted that the food group categories provided to children 6-24 months should be complementary to breastfeeding[81], whereas the food group categories provided to children 24-60 months probably represent the majority of the child's dietary intake[82].

The data show that children in the Title II program area are receiving poor quality diets, with few minerals and nutrients included. The majority of children in all age groups receive less than two food categories in their daily diet. While cereal is frequently provided to every age group of children other food categories are rarely included in the diet. Whereas more than twenty percent of children 6-9 and nearly forty percent of children 9-12 months were reported to have eaten cereal in the 24 hours prior to data collection, no more than ten percent of children in either of these age groups were reported to receive any of the other twelve food categories.

fruit (yellow or red squash, carrot, pumpkin) 4) starches such as potatoes and yams 5) beans 6) other vegetables such as green bean, tomato, eggplant, beet 7) mangos or papayas 8) other fruits such as oranges, grapefruit, and fig 9) red or white meat (pig, beef, goat, chicken) 10) fish meat or seafood 11) eggs 12) any food prepared with milk 13) any food prepared with fat (lard, butter, oil).

[80] The set of thirteen food categories includes two main groupings for vitamin A rich foods: 1) yellow or red vegetable and fruit; and 2) mangos or papayas. The separate categories were created because of the relative difference in the vitamin A content of the foods in each group. The yellow or red vegetable and fruit category is comprised of foods that contain vitamin A, though the vitamin is not contained in large amounts and is not highly bioavailable. The mango or papaya food category, on the other hand, contains not only food fruit rich in vitamin A content, but in a form more highly available than that found in the yellow or red vegetable and fruit category.

[81] While it is recognized that children 6-24 months should receive breast milk in addition to complementary foods, for the purpose of this report, both those children currently breastfed and those children not currently breastfed are included in the dietary diversity analysis.

[82] Although children 24-60 months often no longer receive breast milk, it should be noted that the dietary recall data for this age group may only represent a minimum estimation of the food group categories received. This is because children over two years are increasing mobile and are likely to eat foods independently (e.g. grazing foods) without knowledge of the caregiver. The caregiver of older children may be unaware of all the foods eaten by the child, and, as a result, cannot report the full dietary intake of the child.

Figure 12.6

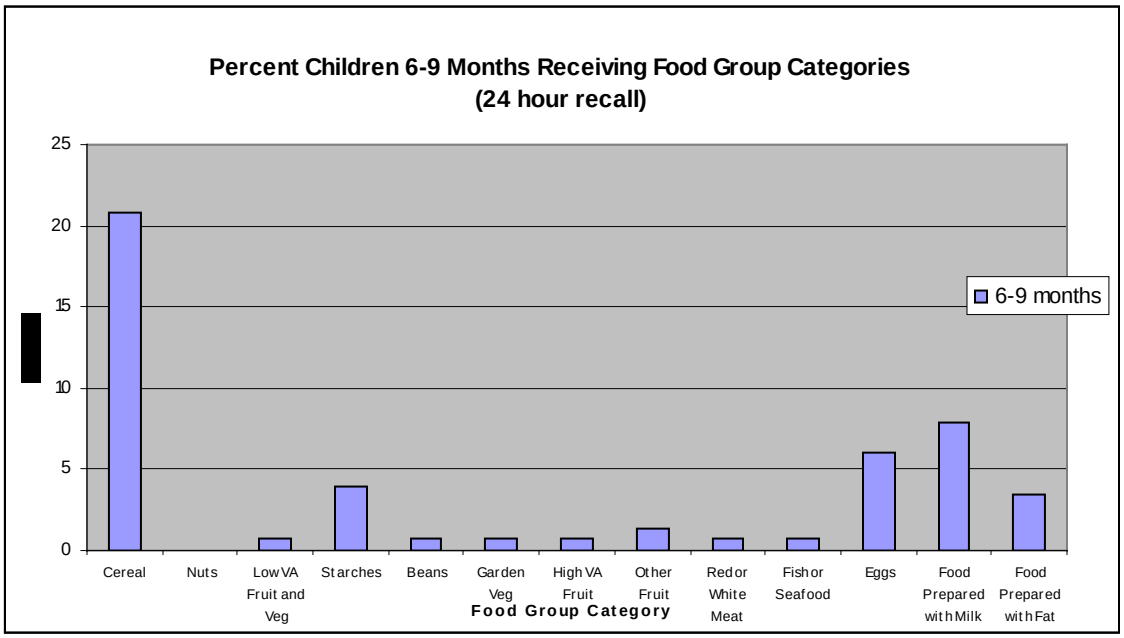
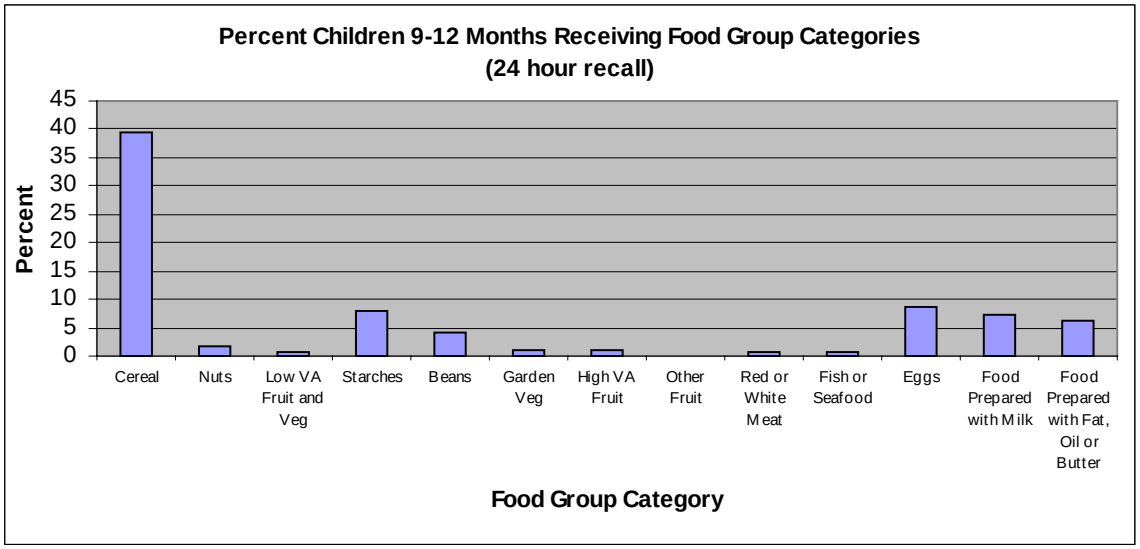


Figure 12.7



Among older children, a similar pattern is evident. Nearly seventy percent of children 12-24 months were reported to have received cereal; yet, no more than fifteen percent of children received any of the other food categories. For children 24-60 months, the range of foods provided is still limited; children receiving a food category other than cereal remains less than twenty percent in all cases.

Figure 12.8

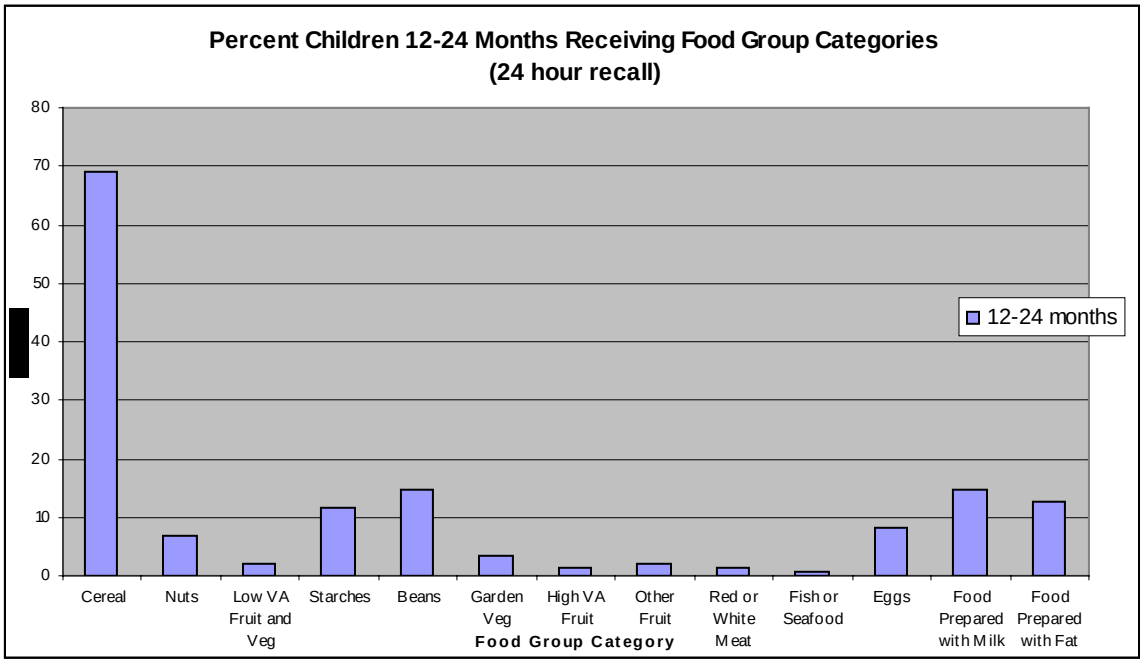
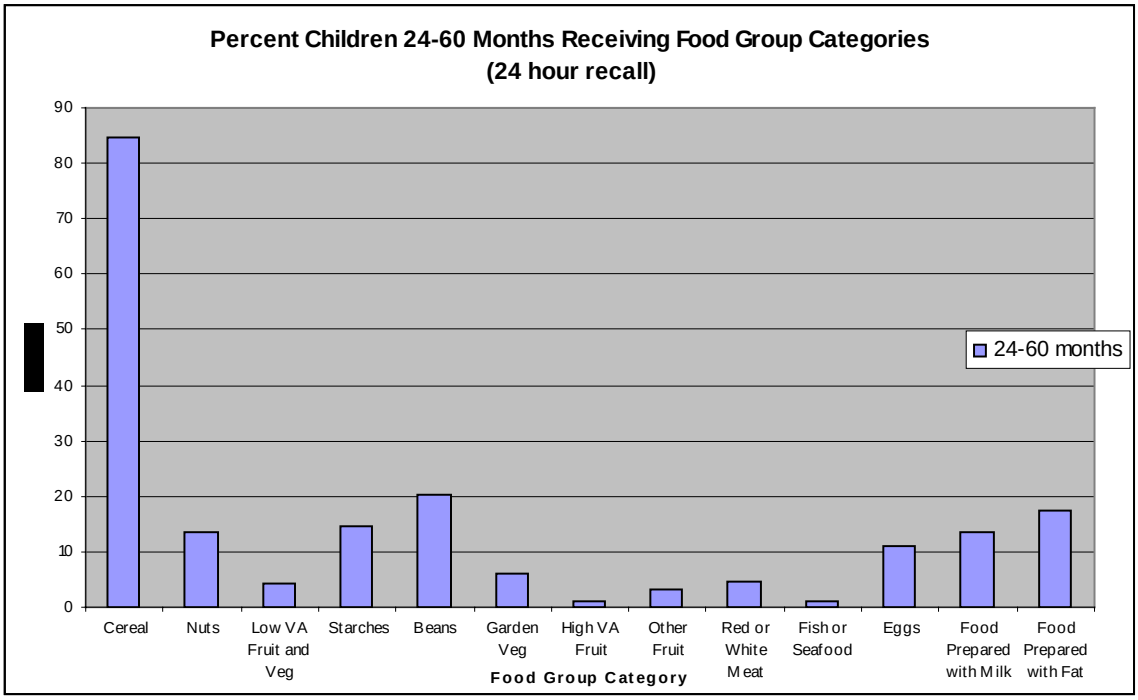


Figure 12.9



These results on dietary intake would indicate that these children are likely at risk for micronutrient deficiencies, including vitamin A, iron, and iodine deficiency, and to a lesser extent, vitamin C, niacin, and thiamin deficiency. Cereal based diets in the absence of fruits, vegetables and animal products, do not provide sufficient minerals and nutrients for growing children. Moreover, many children in the Title II area are likely to have pre-existing low stores

of essential nutrients such as vitamin A, due to the indicated presence of malnutrition, which can reduce the effectiveness of nutrient storage and transport in the body.

The lack of dietary diversity among children of all ages in the Title II Survey area requires attention. The percent of children receiving key food categories such as meat, eggs, and fruits and vegetables rich in vitamin A should be higher for every age group of children in Ethiopia. Moreover, because children 24-60 months are likely not to be breastfed, meals including milk products should be provided to this age group with greater frequency than is occurring currently.

In addition to 24-hour recall data on dietary intake, data were collected on how often certain food categories were provided over the seven days prior to data collection[83]. Six key food categories are addressed: 1) yellow or red vegetable and fruit (not including mango or papaya); 2) mango or papaya, 3) food prepared with milk 4) red or white meat 5) fish or seafood 6) eggs. Each of these food categories is of importance to the health and nutrition status of children. Food sources rich in vitamin A (categories 1 and 2 above), are important for maintaining the integrity of the epithelial cells in body tissue and for supporting proper functioning of the immune system. Food prepared with milk can add calcium to the diet. Other animal products, such as meat, are an important source of protein, zinc, and vitamin B_{12}. Red meat is particularly important, providing an important source of dietary heme iron, a bioavailable form of iron, which, when consumed in adequate amounts, can offer protection against iron deficiency anemia.

Table 12.2 shows the percent of children receiving each of these key food groups at least once over a seven-day recall period, by age group of child. With exception of two food categories (eggs and food prepared with milk), few additional children than those who received the food groups over a 24-hour recall period received any of the key food groups over a seven-day recall period[84]. Animal source foods and foods rich in vitamin A may be areas of particular concern. Among all age groups, the largest difference between those children receiving (low content) vitamin A fruit and vegetables by seven-day recall versus 24-hour recall was only 1.0 percentage points. The fish/seafood category also indicated a difference of only 1.0 percentage point. Similarly, the (high content) vitamin A fruit category showed a difference of only 2.6 percentage points and the red or white meat category showed a difference of only 2.5 percentage points.

Moreover, amongst all age groups, more than seventy five percent of children are not receiving eggs even one time per week and more than ninety five percent of children are not receiving red or white meat. In addition, less than five percent of children of all age groups receive either low or high vitamin A vegetables or fruit at least one time per week. These data provide ample evidence that children fall far short of receiving adequate food group diversity.

[83] The seven day recall period allowed us to obtain a fuller (but admittedly less reliable, due to recall bias) account of the diet.
[84] As said above, recall data is always susceptible to error. Our Ethiopia survey for instance reported a lower percent of children receiving a certain food category using the 7-day dietary recall vs. the 24-hour recall. Thus the difference we report is the proportion of children receiving each food category over the 7 day vs. the 24 hour recall period considers only those data which show a positive result to the equation (% children receiving food category over 7 day recall - % children receiving food category over 24 hour recall).

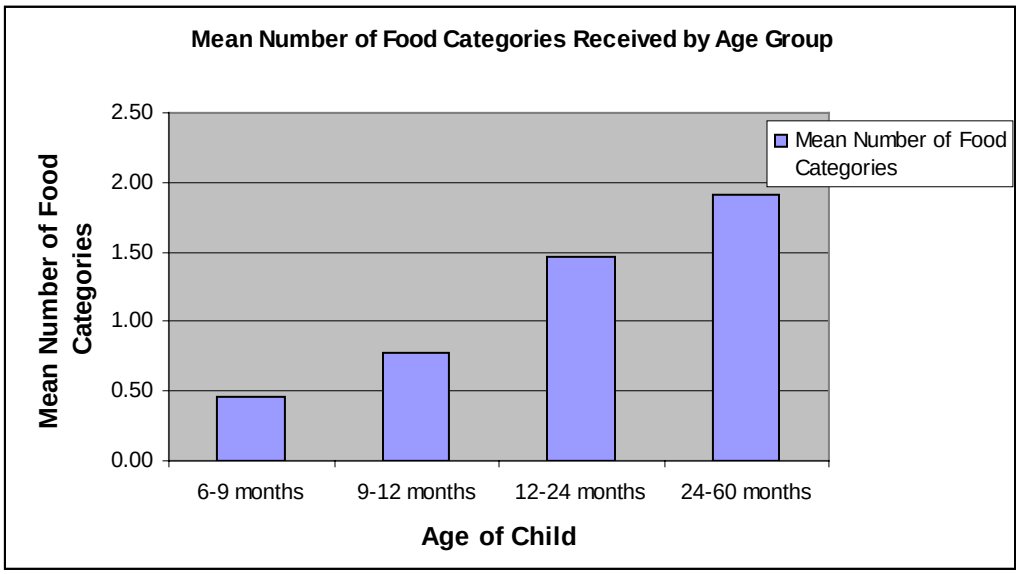
Table 12.2 Percent Children Receiving Key Food Category at least Once in Past Week

Age of Child (months)	Low VA Fruit and Vegetables	High VA Fruit	Red or White Meat	Food Prepared with Milk	Fish/ Seafood	Eggs
6-9	0	3.2	0	17.2	1.7	15.1
9-12	1.6	1.6	1.6	17.9	1.6	24.7
12-24	5.8	3.8	3.8	28	0.6	21.8
24-60	7.9	3.7	8.4	25.2	1.8	24.0

Creation of a Total Food Category Score

In order to gain an understanding of the extent to which multiple food group categories are provided to children, a method developed by Arimond and Ruel (Arimond and Ruel, 2002) has been applied to the Title II Ethiopia data. This method computes a "total food category value" by summing the number of different food categories received by the child in the 24 hours prior to data collection (with a minimum of 0 and a maximum of 13 possible in the case of the Ethiopia Title II Baseline Survey). The main utility of these data are to provide a baseline value for the extent of food group diversity provided.

Figure 12.10



The mean number of food categories received for each respective age group is shown in the figure above (figure 12.10). As might be expected, the number of food categories received increases with age of child, however, for all age groups, the mean number of food categories received is very low. On average, children under 12 months did not receive even one of the thirteen food categories in the 24 hours prior to data collection. For children 12-24 and 24-60 months, the mean number of food groups received was less than two. Although these findings cannot be placed in the context of an international guideline (there are no such guideline yet),

these results indicate low dietary diversity both when compared with other country results (e.g. Haiti in 2002[85]).

Creation of a Dietary Diversity Tercile

The data on number of food categories received can also be summarized so that each child is assigned to a qualitative food diversity category, based on the sample specific distribution of food category intake. This classification is mostly useful as a tool with which change in feeding practices over program duration can be measured. It provides a clear means of examining how the distribution of a number of food categories received within each age group changes over time. In addition, the classification is a useful tool for undertaking certain analytic methods, including bivariate analysis on outcomes of nutritional status, described in more detail below.

For the purpose of this report, a dietary diversity tercile was created, with each child assigned to a high, medium, or low dietary diversity category. The tercile was derived using methods described by Arimond and Ruel in their analytic work for development of a child feeding index[86] (Arimond and Ruel 2002). In the case of the Ethiopia Title II Baseline Survey, the respective minimum cut-off tercile values for low, medium, and high dietary diversity are, for each age group: Children 6-9 months: 0, 1, and 2; Children 9-12 months: 0, 1, and 2; Children 12-24 months: 0, 1, and 2, and Children 24-60 months: 1, 2, and 3[87] (table 12.3).

Table 12.3 Computing Dietary Diversity Terciles: Cut-Off Values by Age Group

Age of Child (months)	Low Dietary Diversity	Medium Dietary Diversity	High Dietary Diversity
6-9	0 food categories	1 food category	2 or more food categories
9-12	0 food categories	1 food category	2 or more food categories
12-24	0 food categories	1 food category	2 or more food categories
24-60	0 or 1 food category	2 food categories	3 or more food categories

[85] Data from the Haiti Joint Title II Baseline Survey (2002) showed children 6-9 months to receive an average of 3.42 food categories in their daily diet, and children 9-12 and 12-24 months to receive a respective average of 4.49 and 4.99 food categories in their daily diet. Children two years and beyond received an average of more than five food categories in their diet in the 24 hours prior to data collection (Bergeron, G and Deitchler M 2003). These data from Haiti were collected and analyzed by the same methodology as applied in the Ethiopia Joint Baseline Survey, however, the questionnaire in Haiti asked only about a total of 11 different food categories, whereas in Ethiopia the questionnaire asked about a total of 13 different food categories.

[86] These methods suggest that within each age group of children (i.e. 6-9 months, 9-12 months, 12-24 months), every child be assigned to a tercile level, based on the number of different food categories the child has received in comparison to other children of the same age group. Thus, for each age group, the 33.3 percent of children receiving the highest number of different food categories are assigned to the top tercile (high dietary diversity category), the middle 33.3 percent are assigned to the second tercile (medium dietary diversity category), and the bottom 33.3 percent are assigned to the lowest tercile (low dietary diversity category). In this way, the dietary diversity tercile cut-off values for each age group reflect age specific practices for diverse food category intake among the survey sample. It should be recognized, however, that the classification of children into dietary diversity terciles can only be approximated into equal thirds, as best as possible. It is rarely possible that the distribution of children's total food category score allows for the sample to be divided perfectly into tercile groups.

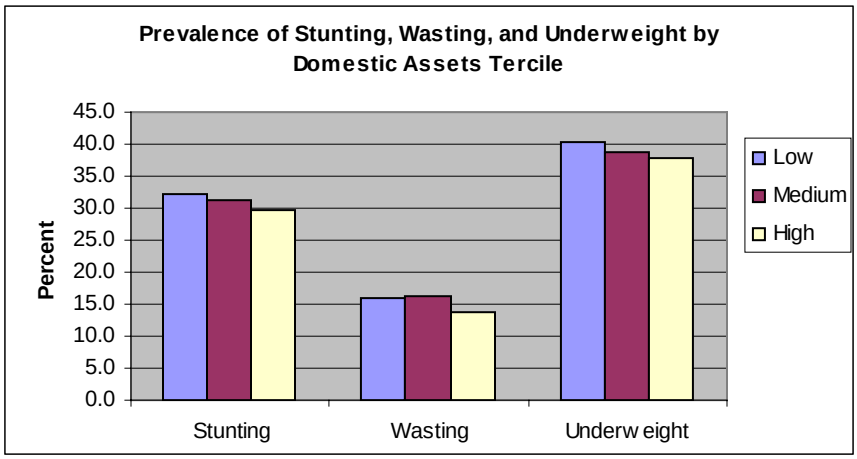
[87] While it is rarely possible that the distribution of children's total food category score allows for the sample to be divided perfectly into tercile groups, in the case of Ethiopia, the distribution of children's food category score is skewed toward the lower end, causing the number of children in each tercile level to be more unequal than would generally be expected. The percent of children included in each tercile level are as follows for each age group: 1) Children 6-9 low=71.0%; medium=17.9%; high=11.1%. 2) Children 9-12 months low=50.9%; medium=31.4%; high=17.7% 3) Children 12-24 months low=21.2%; medium =38.6%; high=40.2%; 4) Children 24-60 months low=53.6%; medium=30.3%; high=24.6%.

Bivariate Analyses: Socio-Economic Status and Child Nutritional Status

In order to gain a preliminary understanding of the extent to which certain infant and child feeding practices may be related to child nutritional status, bivariate analyses have also been undertaken. In considering the findings, it should be recognized that the results presented from bivariate analyses do not provide a definitive answer as to the relation between the behavior of interest and the outcome of study. Instead, the analyses should be considered as a preliminary indication of possible relationships between variables. More definitive results about these associations will be derived from multivariate analysis, treated in the final Chapter of this report. For each association tested in this Chapter, children 6-24 months are included in the analyses.

Analyses of the association between household wealth and dichotomous nutritional indicators indicate a linear relationship between levels of socio-economic status (SES)[88]and the prevalence of stunting, wasting, and underweight (figure 12.11), such that the prevalence of malnutrition is shown to improve with increased SES. The difference in the prevalence of malnutrition between SES categories is, however, not substantial; only a small improvement in nutritional status is shown between high and low wealth categories for each of the anthropometric indicators.[89]

Figure 12.11



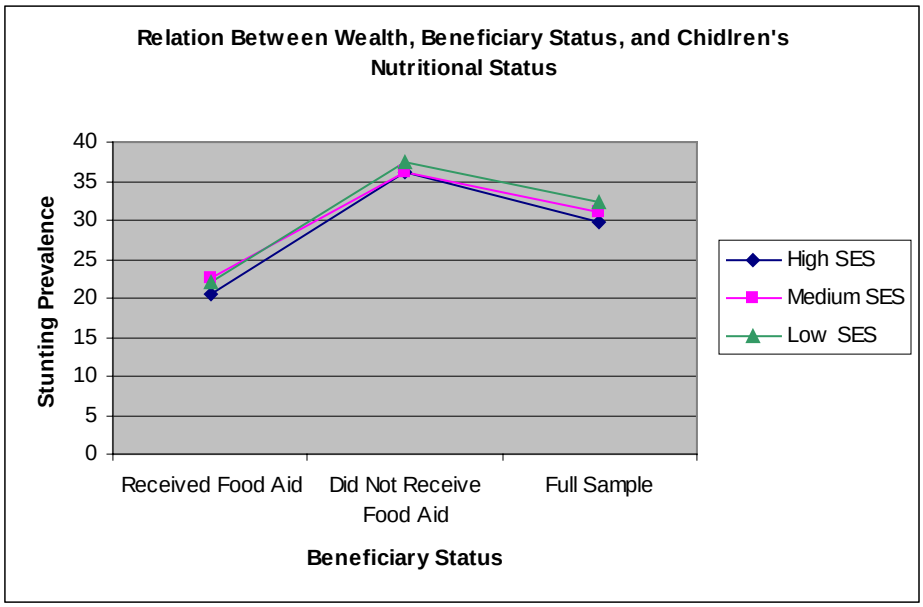
It is often suggested that household wealth enables caregivers to provide higher quality diets to their children and to adopt recommended preventative and recuperative health practice. Wealth also often correlates with other factors likely to influence children's nutritional status, including caregiver education level and access to water and sanitation resources. The lack of a strong association between household wealth and child malnutrition in the Title II area was therefore unexpected, but can perhaps be explained.

[88] In this report, socio-economic status is also referred to as 'household wealth.' The low, medium, and high SES values have been derived as sample specific tercile categories, and are created from an index variable for household domestic assets (for more details, refer to Chapter Six).

[89] The difference in the prevalence of malnutrition for each anthropometric indicator, by extreme household SES categories is as follows: stunting – 2.4 percentage points (pp), p value=0.489; wasting – 2.1 pp, p value=0.432; underweight – 2.5 pp, p value= 0.508.

Due to the persistent drought affecting the Title II area during May-August 2003, many households included in the Joint Baseline Survey were either current or recent beneficiaries of food aid. More than 40 percent of household with children under 2 to reported having received supplementary food from an NGO in the thirty days prior to data collection. When taking this factor into account, the relationship between household wealth and children's nutritional status is better explained. As shown in figures 12.12-12.14, within each SES category, the prevalence of malnutrition is notably lower among those households receiving food aid[90]. The results indicate beneficiary status to be more directly related to children's nutritional status than SES. These findings are shown most clearly for the indicators of stunting and underweight (figures 12.12 and 12.14). The weak relationship between household wealth and children's nutritional status is now more fully contextualized; beneficiary status was previously masking the difference between SES categories.

Figure 12.12



[90] This trend by beneficiary status is demonstrated for all anthropometric indicators and SES categories, the only exception being the results obtained for the prevalence of wasting among the middle SES category.

Figure 12.13

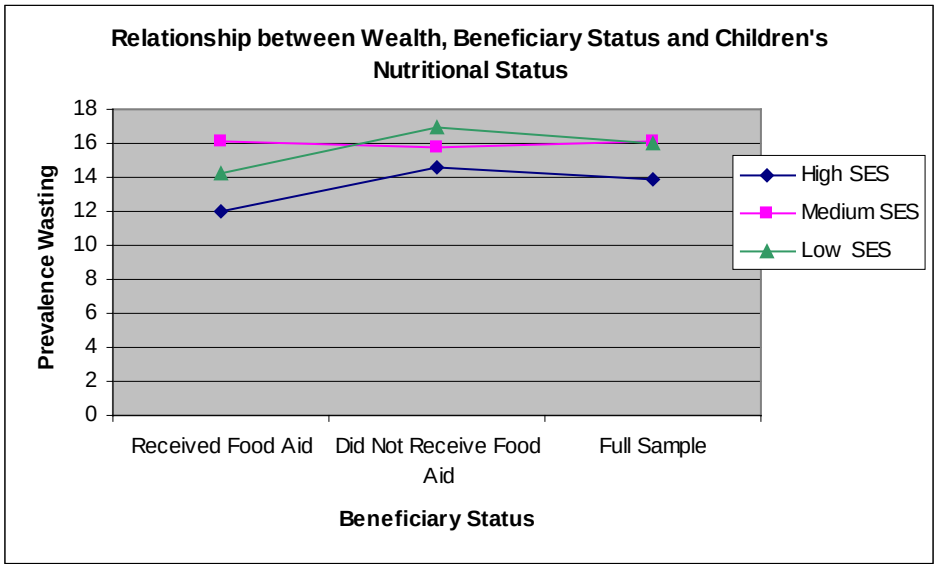
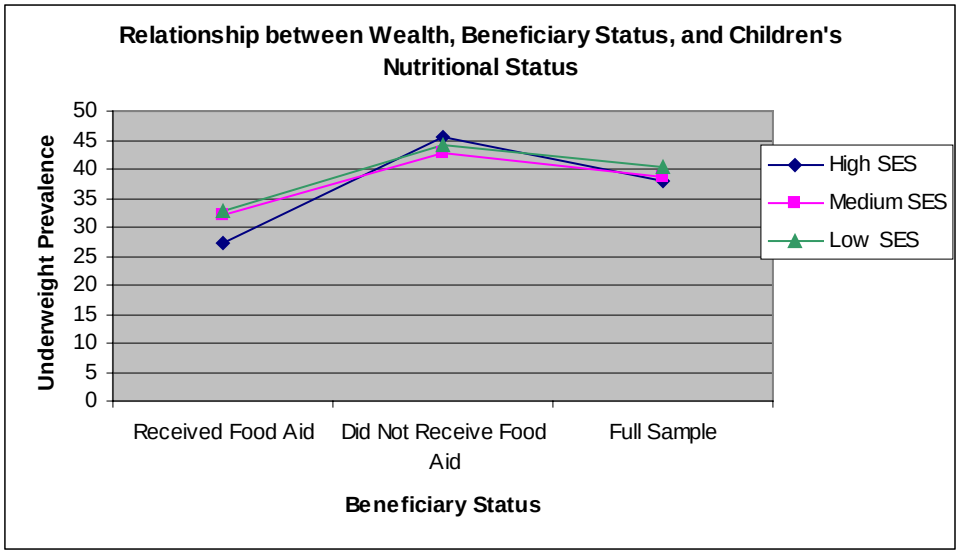


Figure 12.14



Two additional hypotheses can be considered: 1) the categories of household wealth do not represent meaningful differences between levels of wealth; instead, all households in the Title II program area may, in essence, be "poor". Put differently, even the households in the high wealth category may lack sufficient resources for adoption of positive health, nutrition, and caregiving practices. This hypothesis would seem particularly pertinent during a drought or emergency period, such as that which occurred in 2003. If this were the case, we would then expect to see only minor differences in the nutritional status of children to be demonstrated between extreme wealth categories; 2) because the categories of household wealth do not incorporate a factor to control for the duration of time at the household's current wealth status, the relationship of household wealth to each of the anthropometric indicators may not be specific enough to show

clear results. Low height-for-age (stunting), for example, is a result of chronic malnutrition, and, if strongly associated with household wealth, would be expected to be most prevalent among children in households having been classified in the poor SES category over a longer period of time. Wasting, on the other hand, is the result of current malnutrition, and therefore might be more prevalent among children in households that have more recently become classified as poor. Because wealth categories are likely to fluctuate during periods of drought or emergency, controlling for the duration of time a household has maintained a current level of wealth could have important relevance in the case of the Ethiopia Title II Baseline data. Unfortunately, we do not have this type of data available. Still, additional insight into the association between household wealth and children's nutritional status will be offered in Chapter 16, when we explore the relationship in greater detail, by applying a multi-variate model to the data.

Bivariate Analyses: Infant and Child Feeding Practices and Child Nutritional Status

The bivariate relationships between infant and child feeding practices and child nutritional status were also tested. Infant and child feeding practices such as use of bottle, continued breastfeeding; and complementary feeding practices, including, frequency and quality of complementary feeding, were of primary interest. In the results presented below, each of these practices is analyzed in relation to nutritional outcomes of interest.

While illuminating, the bivariate associations presented below should be considered with caution as such analyses do not account for the effect of multiple factors on an outcome, or the influence of potential confounding variables on the relationship of interest. The main utility of the findings below is to highlight potential relationships between individual feeding practices and children's nutritional status. The results also help to inform the multi-variate modeling explored in Chapter 16.

In exploring the relationship of feeding practices with children's nutrition, few bi-variate associations were shown as statistically significant, and of those that were, none went in the expected direction. Said otherwise, whereas we could not confirm the effect of any positive practice on children's nutritional status, certain negative feeding practices appear to significantly improve that status. For example children not currently breastfed appear less likely to be underweight, (breastfed) children not receiving the recommended minimum number of complementary feeds per day appear are less likely to be stunted, as are children receiving low dietary diversity (all results being statistically significant).

One explanation for the unexpected findings is that certain variables in the dataset show little differentiation between categories. As shown earlier (refer to table 12.3), for every age group of children there is little difference in the number of food categories received for those children in the low vs. high dietary diversity categories. Whereas most children in the low dietary diversity category had received zero food categories in the last week, most children in the high dietary diversity category had received just two food categories. As a result, the nutritional impact of being in a low vs. high dietary diversity category may not be very meaningful. Rather, the relationship indicated as statistically significant is, in this case, likely to be spurious and not actually attributed to a difference in food group diversity received by the child.

Second, the results may be confounded by variables that are unaccounted for. For example, as shown in table 12.4, bottle use is significantly associated with improved nutritional status. Bottle use is, however, a negative feeding practice and would not be expected to demonstrate a positive association. But bivariate analyses do not consider multiple factors that may be related to the variable of interest. By consequence, the results indicated by bi-variate analyses may not, in fact, represent the true nature of how the variables relate to each other. It is possible, for example, that bottle use is confounded by the influence of socio-economic status on children's nutritional status. In fact, this has often been the case for other developing countries reporting a similar finding (e.g. Haiti in 2002, see Bergeron, G and Deitchler, M 2003).

Related to concerns about confounding is the thought that certain feeding practices might be best examined together in relation to nutritional outcome measures, that is, when the effect of each is taken into account in the explanatory equation. For example, it may be that breastfed children indicated as underweight are not receiving feedings with sufficient frequency, and/or that breastfed children are not receiving sufficient diversity from complementary feeding. Similarly, (breastfed) children fed the minimum recommended number of times per day may not be receiving food in sufficient quantity at these feedings and/or may not be receiving high quality foods in their diet. Each of these scenarios could provide an explanation for the unexpected results. These possibilities will later be tested by multi-variate analysis, which will allow to control for the independent effect of each practice on the outcome of interest. It will then be possible to make a more definitive statement on the relationship between feeding practices and children's nutritional status in the Title II Program area in Ethiopia.

Table 12.4 Relationship between Infant and Child Feeding Practices and Prevalence of Stunting, Wasting, and Underweight

Feeding Practice	Stunting (%)	Wasting (%)	Underweight (%)
a. Continued Breastfeeding			
1. Currently breastfed	31.1	15.8	41.0
2. Not Currently breastfed	29.0	13.7	24.4
P value	P=0.631	P=0.538	P=0.000
b. Complementary Feeding Frequency[91]			
1. Minimum feeding frequency recommendation met	35.1	15.1	41.7
2. Minimum feeding frequency recommendation not met	25.0	16.3	37.1
P value	P=0.002	P=0.634	P=0.190
c. Dietary Diversity			
1. High dietary diversity score	36.2	16.1	39.4
2. Medium dietary diversity score	36.3	13.6	44.4
3. Low dietary diversity score	19.5	15.4	32.9
P value[92]	P=0.000	P=0.799	P=0.087

[91] For all bivariate analyses that explore the relationship of feeding frequency with children's nutritional status, only breastfed children 6-24 months are included in the analysis. Exclusion of non-breastfed children is due to the lack of established guideline on feeding frequency for this sub-group of children.

Feeding Practice	Stunting (%)	Wasting (%)	Underweight (%)
d. Bottle Use			
1. No bottle use	34.6	17.4	43.2
2. Bottle use	20.6	9.8	27.2
P value	P=0.000	P=0.002	P=0.00

Key Findings and Program Implications

From the results presented in this chapter, it is clear that certain recommended infant and child feeding practices are already recognized and commonly implemented in Ethiopia. Those positive practices include:

- Feeding colostrum to the child; and
- Breastfeeding

Several gaps in knowledge and/or behavior related to feeding practices in Ethiopia are also highlighted by the results presented thus far. These include:

- The low percent of children in Ethiopia receiving exclusive breastfeeding on the day of birth and throughout the first six months of life;
- The use of bottles for feeding children;
- The low percent of children, particularly, 6-12 months, receiving the appropriate frequency of complementary feeds; and
- The low food group variety that all children are receiving

Efforts to reinforce the positive practices already common in Ethiopia should continue and increased attention to the identified gaps in knowledge and behavior is recommended. Some specific program recommendations follow.

Because continued breastfeeding (up to 24 months), appropriate frequency of complementary feeding, and dietary diversity are known to be important to children's nutritional status, efforts to increase caregiver knowledge about these feeding practices, and guidance on how to implement these recommended feeding practices should continue. Formative research may be required in order to learn culturally feasible methods for caregivers to improve the quality of foods and increase the minerals and nutrients provided to children.

Moreover, it should be considered that certain infant and child feeding practices may be related to or enabled by socioeconomic status. Efforts to increase household income would seem therefore likely to benefit child nutritional status. Increased opportunities for appropriate income generating activities for women are of particular relevance. Providing domestic based income generating activities allowing for less separation between women and their children might enable improved feeding practices. Moreover, increased household income may facilitate the ability to provide increased feedings, as well as a diverse group of food categories at each feeding.

[92]The p value here represents the statistical significance of the difference between extreme categories of the independent variable, in this case, the difference between high and low dietary diversity categories.

Interventions encouraging women to take children with them when leaving the home, or to express breast milk before leaving the home are also recommended.

Chapter Thirteen. Child Health

Appropriate prevention and treatment of infection and disease are essential to protect a child's nutritional status. As described in the applied conceptual framework (refer to figure 11.1), children's health and nutritional status are closely related. In the presence of infection and disease, appetite as well as the absorption and utilization of nutrients may diminish. Similarly, children who are malnourished are not as resistant to illness, disease, and infection. Children's health status is therefore both an underlying causal factor, and a related outcome of malnutrition. Information on the status of children's health and practices related to child health are thus key, not just for the protection and promotion of child health in general, but also to gain an understanding of the specific conditions which cause and sustain child malnutrition in Ethiopia.

The Baseline survey provides data on the prevalence of illness (fever, cough, diarrhea) among children, as well as information on if treatment was sought by caregivers, the extent to which recommended preventative and treatment practices are followed, and what remedial action may be taken to improve health care practices among caregivers.

Childhood Immunization

To gain information on preventative child health practices and coverage of primary health care, the Joint Baseline Survey collected detailed data on vaccinations received by children in the Title II area. There were several steps involved in the data collection process. First, the principal caretaker was requested to produce the child's health card. If the health card was made available, the enumerator transcribed all information on vaccination and vitamin A supplementation received. The enumerator then asked the respondent about other vaccinations or vitamin A capsules the child may have received, which were not recorded on the health card. This survey feature was included to accommodate the reality that vitamin A and certain vaccinations are not routinely recorded on health card when administered as part of an immunization day or EPI campaign in Ethiopia.

In the Title II area in Ethiopia, only forty percent of children 6 months to 5 years were reported to have a health card. In the case the child did not have a health card, all information on vaccinations and vitamin A supplementation had to be obtained by caregiver recall.

The vaccination coverage results in Table 13.1 indicate serious inadequacies in caregiver practices and the health care delivery system. The cells in the table represent a joint tabulation in which the vaccination coverage for children with health cards and children without health cards are aggregated. These values include vaccinations reported by recall for children with health cards[93]. The parenthetical notes in Table 13.1 provide the disaggregated coverage rates for children with cards and children without cards, respectively. While nearly three out of four children are reported to have received a BCG vaccination, the coverage rate for other vaccinations is substantially lower. Less than one in three children in the Title II area is fully immunized against polio and only one in two children have received the full course of DPT

[93] It might be noted, however, that for those children having health cards, little additional vaccination information was obtained by caregiver recall. The coverage reported reported from card documentation alone, for children 12-60 months are 91.4, 68.2, 68.7, and 74.4 percent for BCG, Polio3, DPT3, and measles, respectively.

vaccinations. Yet, vaccinations such as BCG, Polio, DPT, and measles are key components to reducing child morbidity and mortality.

Table 13.1 Vaccination Coverage Rate

	BCG	Polio3	DPT3	Measles
12-24mo	73.1 (94.0) (57.8)	32.6 (64.8) (8.1)	46.1 (68.4) (29.3)	57.7 (73.4) (45.3)
24-36mo	71.9 (88.9) (64.1)	31.5 (71.2) (11.6)	50.8 (71.6) (40.2)	59.4 (73.3) (52.7)
36-60mo	72.5 (89.7) (68.0)	31.7 (75.9) (19.3)	51.5 (69.0) (46.7)	64.2 (82.8) (59.0)
Total				
12-60mo	72.5 (91.4) (63.6)	32.0 (69.2) (13.3)	49.3 (69.6) (39.2)	60.3 (75.2) (52.7)

The low percent of children achieving full immunization status by12 months of age further highlights the gap existing in preventative health care practices (table 13.2). Of those children having a health card, only 15.2 percent of children 12-24 months of age have received the full course of recommended vaccinations, as documented by health card or by caregiver recall[94]. Among older age groups, we would expect to see an increase in the proportion of children fully immunized, given that increased age means an increased time period over which the required vaccinations could have been received. In the case of Ethiopia, however, the proportion of fully immunized children decreases for older age groups. Among children with a health card, only 9.1 percent of children 24-36 months and 9.7 percent of children 36-60 months are fully immunized. The higher vaccination rate recorded among younger children could reflect recent increased immunization efforts or might be a result of improved documentation of vaccine provision over the last two years.

For those children not having a health card, immunization status could be obtained only by caretaker recall. Among these children, vaccination rates are even lower (table 13.2). Only 3.9 percent of children 12-24 months are indicated as fully immunized. The vaccination rate increases only slightly for the older age groups of children; only 5.5 percent of children 24-36 months, and 9.0 percent of children 36-60 months are reported to be fully immunized.

Vaccination coverage by analysis of the full sample of children is shown in the far right column of Table 13.2. The full sample analysis indicates that no more than 10 percent of any age group of children is fully immunized in the Title II Program Area. This low are of immunization coverage warrants immediate attention by the CSs. We suggest that Cooperating Sponsors increase their support to appropriate instances, to expand vaccination coverage rates in their area of intervention. Immunization campaigns should both increase efforts to cover children of the targeted age group, as well as aim to reach older children who have not yet received the full course of recommended vaccinations.

[94] The vaccination coverage achieved by children with a health card is only slightly lower when tabulated by health card data only. The full immunization coverage reported for children 12-24, 24-36, and 36-60 months is 13.7, 8.2 and 7.6 percent, respectively.

Table 13.2 Percent Children Fully Immunized

Age of Child[95] (months)	Children with cards (%)	Children without cards (%)	Full sample (%)[96]
12-24	15.2	3.9	9.1
24-36	9.1	5.5	6.8
36-60	9.7	9.0	9.2
Total			
12-60	12.0	6.3	8.3

Distance to immunization services is not indicated here as an important factor for adherence to the recommended immunization schedule (table 13.3). This finding could be due to the lack of differentiation in the sample (only 8.3 percent of children 12-60 months received the full course of vaccinations) or could be a result of a number of other factors. It is possible, for example, that caregivers are not fully aware of the recommended course of childhood vaccinations. Alternatively, caregivers may lack the resources to provide the care needed to adhere to the recommended vaccination schedule[97].

Table 13.3. Relationship between Child Immunization and Distance to Immunization Services

Mean Distance to Closest Immunization Services (minutes)	Child is Fully Immunized
101.1	Yes, Child is fully immunized
105.2	No, Child is not fully immunized
T value, P value	0.381, 0.703

Vitamin A Supplementation of Children

In countries where vitamin A deficiency is a problem, WHO recommends that children 12 to 59 months receive vitamin A capsule supplementation, as a single dose of 200,000 IU every four to six months. Among those children having a health card in the Title II area, 26.4 percent of children between 12 months and 5 years are reported by health card documentation or caregiver recall to have received a vitamin A capsule supplement in the last six months[98]. Among those children not having a health card, 28.5 percent were reported to have received vitamin A capsule supplementation within the last six months (table 13.4).

[95] Data on immunization were also collected for children 6-12 months; the data are not reported here given that the recommended schedule for receiving vaccinations is not completed before 12 months of age.
[96] This last column combines the two prior columns.
[97] By lack of resources for providing care, we are not referring only to the financial cost of taking the child for vaccinations and the financial resources necessary to travel the distance to the venue, but also to general demographics which could influence the ability of a caregiver to carry out recommended practices. These demographic variables, or resources for care giving, would include elements such as caregiver education level, number of children in the household, status of the mother in the household, and household type (i.e. male or female headed household). A discussion of these resources for care giving, and an analysis of their relationship with infant and child feeding and preventative and curative child health practices are presented in Chapter 14.
[98] Although vitamin A supplementation is not routinely reported on health cards, for those children with health cards, vitamin A supplementation was documented among roughly one half of those children reported to have received a vitamin A capsule.

Table 13.4 Percent of Children Receiving Vitamin A Supplementation

Age of Child (months)	Children with health card (%)	Children without health card (%)	Full sample (%)
12-24	24.2	25.1	24.7
24-36	27.2	30.1	29.1
36-60	30.3	29.7	29.9
Total			
12-60	26.4	28.5	27.8

Deficiencies in vitamin A have various negative implications for child health, nutritional status, and mortality. The potential consequences of vitamin A deficiency include diminished cellular integrity, immunocompetence, and increased mortality risk by up to 23 percent (Underwood 1998, Beaton 1993). The specific health impacts imposed on an individual by vitamin A deficiency depend, to a large degree, on the extent of the deficiency. The main effects of sub-clinical vitamin A deficiency are related to immunocompetence, both in susceptibility for acquiring infection and illness, as well as increased severity of those illnesses experienced. Clinical vitamin A deficiency often manifests itself through defects in ocular tissue, causing negative changes in vision (e.g. night blindness) and potential corneal disease (e.g. corneal xerosis, ulceration, or keratomalacia) (WHO 1996).

Various indicators can be used to estimate the prevalence of vitamin A deficiency. These include indicators that capture sub-clinical (serum retinol), clinical (eye signs, bitot's spots, keratoclamia), or the functional (night blindness) manifestations of vitamin A deficiency. For the Ethiopia baseline survey, the prevalence of vitamin A deficiency among children was estimated by caregiver report, using the local term for night blindness.

Data collected from the baseline survey indicate the prevalence of child night blindness in the Title II area to be high, at around 4.7 percent for children over 24 months[99]. These data indicate that vitamin A deficiency may be a serious problem among children under five years, and, moreover, that vitamin A deficiency is likely also a problem among other vulnerable groups such as pregnant and lactating women.

To protect children in Ethiopia against vitamin A deficiency, increased prevention efforts are required. Adequate intake of vitamin A rich food is the preferred method for preventing vitamin A deficiency. But, as discussed in Chapter 12, the percent of Ethiopian children receiving vitamin A rich fruit and vegetables with regular frequency is very low. Interventions for increasing household access to vitamin A rich fruit and vegetables are therefore recommended. These interventions might include home-gardening efforts, coupled with education messages on the importance of providing foods such as mango or papaya, when available, or preparing foods with red palm oil, also a good source of vitamin A. Interventions aimed at increasing household wealth might also offer benefits, since dietary diversity and consumption of higher quality food

[99] Data on night blindness were collected for children 6-60 months, however, only children 24-60 months were considered here (tabulations not shown). Children 0-24 months were excluded from the analysis in an effort to follow, as best as possible, the WHO recommendation that the night blindness indicator be reported for children 24-71 months (WHO 1996).

are normally associated with household wealth. In addition, Cooperating Sponsors could direct efforts towards improving the vitamin A supplementation coverage rate, currently shown as below 30 percent for every age group of children.

Prevalence of Childhood Illness (Fever, Cough, Diarrhea)

Data on childhood illness were collected at the beginning of the wet season, when episodes of malaria and diarrhea might be expected to occur with greater frequency than normal. Due to the potential effect of seasonality on the disease prevalence, follow up data collection should occur during the same time of year, in order to ensure comparability between surveys.

The Survey shows high rates of illness and disease for children of all ages in the Title II area. Among children 6 months to 5 years, one in two children were reported to have some sort of illness or disease, such as a cough, fever, or episode of diarrhea, in the two weeks prior to data collection. Specifically, nearly one in four children were reported to have suffered an episode of diarrhea and one in three children were reported to have had a cough or fever. Multiple episodes of sickness (two or more)[100] were also commonly reported, with the frequency of multiple episodes of illness especially high among children less than three years. In the two weeks prior to data collection, 33.1 percent of children 6-36 months were reported to have experienced multiple episodes of illness, compared to 18.5 percent of children 36-60 months (table 13.5).

Table 13.5 Prevalence of Childhood Illness

Age of Child (months)	Diarrhea (%)	Cough (%)	Fever (%)	Any Sickness[101]	Multiple Sickness (%)
0-6[102]	16.2	N/A	N/A	N/A	N/A
6-12	32.0	37.6	38.2	55.4	36.8
12-24	32.4	33.9	33.9	55.3	33.3
24-36	27.6	32.4	31.6	51.3	31.1
36-60	12.7	23.4	21.3	35.9	18.5
Total					
6-60	25.7	31.1	30.4	49.0	29.1

Care Seeking Practices for Childhood Illness

As shown in table 13.6, child health care seeking and treatment decisions most often involve the mother and father of the child. Mothers and fathers are reported to have a decision making role with nearly equal frequency for all age groups of children. The role of grandmothers in making health related decisions for a child is also indicated, though much less frequently. These data provide important information for the targeting of health-related messages. The findings suggest

[100] Multiple episodes of illness is defined here as the occurrence of two or more different illnesses (fever, cough, or diarrhea) in the two weeks prior to data collection. Those children who may have experienced more than one episode of the same illness are not represented as having experienced multiple episodes of illness.
[101] Any sickness refers to a child having been reported to have an episode of cough, diarrhea, or fever in the two weeks prior to data collection.
[102] Data on the prevalence of cough and fever were not collected for children 0-6 months.

that Cooperating Sponsors should consider multiple target groups for child health and behavior change messages. Given the frequency with which fathers and grandmothers are involved in decisions related to child health care, it would clearly be a missed opportunity not to target them, in addition to mothers when disseminating health related messages.

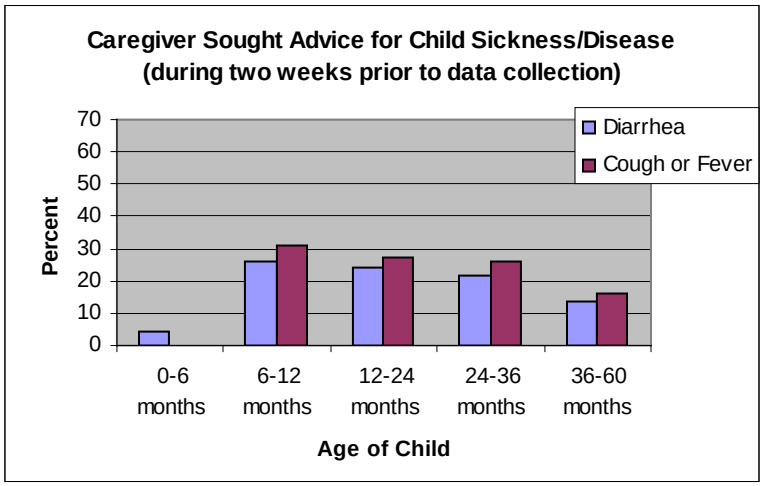
Table 13.6 Individual with Decision Making Role for Seeking Child Health Care[103]

Age of Child (months)	Mother has Decision Making Role (%)	Father has Decision Making Role (%)	Grandmother has Decision Making Role (%)	Other person has Decision Making Role (%)
0-6	87.0	82.6	4.1	2.4
6-12	82.5	86.5	2.0	0.6
12-24	83.6	81.6	3.6	0.3
24-36	85.7	81.0	5.2	1.0
36-60	81.9	76.7	4.5	1.3
Total				
6-60	83.6	80.8	4.1	0.8

Care seeking behaviors vary according to age of child and type of illness present. Advice for treatment of fever, cough, and diarrhea is more commonly sought for younger as opposed to older children and is more commonly sought for cough or fever than for diarrhea. Whereas roughly one in four caregivers sought treatment advice for ill children less than three years, only about one in six caregivers sought advice for ill children between three and five years (figure 13.1). Children under six months are, however, a special case. Whereas around 25 percent of caretakers with children 6-36 months sought counsel for treatment of diarrhea, only 4.5 percent of caregivers with children 0-6 months reported having sought advice for treatment of diarrhea.

[103] These data reflect the responses given to the question: "When your child or one of your children is seriously ill, who decides to bring the child to receive medical treatment?" This question has therefore been used as a proxy indicator for the status of the mother in the household, specifically, if she has a decision-making role in seeking health care for the child. The question allowed for multiple responses to be mentioned by the respondents. For tabulation purposes, each category is treated separately, so that the percentage cited reflects the percent of total cases indicating the category of interest as a response.

Figure 13.1



The low percent of caregivers seeking treatment advice for children should be considered, but children between 0 to 6 months should be offered special attention. Given the recommendation that children under six months be exclusively breastfed, the appropriate treatment protocol for children under six months may be confusing for many caregivers. It is possible that appropriate treatment for cases of diarrhea may not be well known and/or practiced. Education about appropriate treatment of diarrhea for children less than six months of age may be necessary.

Of those caregivers who seek advice for treatment of fever, cough or diarrhea, most caregivers report taking the child to a public health station or clinic at the PA level (tables 13.7, 13.8). Health centers and private health clinics are also commonly used and traditional health care providers, particularly for older children, are further indicated as an important resource for treatment advice. In the case of cough or fever, 11 percent of caregivers with children between the ages of 36 to 60 months sought advice at a traditional medical source. For diarrhea, the percentage was higher; 16.7 percent of caregiver sought treatment advice at a traditional or non-medical source, such as from a traditional practitioner (certified and uncertified), church or mosque, or itinerant salespeople. Hospitals and health posts/community health services are used less frequently, and pharmacies/drugstores, health agents, and TTBAs even more rarely.

It seems distance to health facilities may not be the only factor influencing where treatment advice is sought. As shown in Chapter five, health posts are among the health services reported to be located in closest proximity to each community. These community health services are not, however, utilized often by caregivers seeking treatment advice for a common childhood illness. Only 6.8 percent of caregivers (of children 6-60 months) seek treatment advice for cough or fever among the community health services available, and, similarly, only 6.1 percent of caregivers (of children 6-60 months) seek treatment advice for diarrhea from community health services.

Table 13.7 Where Caregiver Sought Treatment Advice for Childhood Cough or Fever

Age of Child (months)	Hospital	Health Center	Private Health Clinic	Public Health Station/ Clinic (PA)	Pharmacy/ Drugstore	Health Post/ Community health services	Tradtl[104]	Health Agent	TTBA
6-12	3.9	16.0	16.0	54.0	2.0	6.0	2.0	2.0	0
12-24	12.4	27.6	18.4	26.4	2.3	5.7	5.7	2.3	0
24-36	6.3	30.0	8.9	35.4	2.5	8.9	7.6	0	1.3
36-60	8.3	31.4	2.9	40.0	0	5.7	11.4	0	0
Total									
6-60	8.2	26.6	12.7	36.7	2.0	6.8	6.4	1.2	0.4

Table 13.8 Where Caregiver Sought Treatment Advice for Childhood Diarrhea

Age of Child (months)	Hospital	Health Center	Private Health Clinic	Public Health Station/ Clinic (PA)	Pharmacy/ Drugstore	Health Post/ Community health services	Tradtl[105]	Health Agent	TTBA
0-6[106]	20.0	40.0	20.0	20.0	0	20.0	0	0	20.0
6-12	3.2	16.1	3.2	54.8	6.5	0	9.7	0	3.2
12-24	6.1	24.2	21.2	30.3	9.1	6.1	6.1	0	1.5
24-36	4.1	28.6	10.2	36.7	8.2	6.1	10.2	0	2.0
36-60	11.1	33.3	22.2	22.2	16.7	16.7	16.7	5.6	5.6
Total									
6-60	5.5	25.0	14.6	36.0	9.1	6.1	9.1	0.6	2.4

These findings provide important information about common reference sources for child health and treatment information. The results show community health services in the Title II Program area may not be optimally utilized by child caregivers. Depending on the function the community health services are intended to provide, there may be a need for Cooperating Sponsors to increase awareness to communities about the services offered at health posts. Increased outreach of the health agents may also be necessary. Alternatively, the data may indicate a gap in the range and quality of services provided at health posts, by health agents, and among other points of community health service. The Title II Cooperating Sponsors in Ethiopia might consider if efforts to improve the quality of services provided at these service points would instead be useful, ultimately allowing for quality health care to be more accessible. At the same

[104] Traditional/non-medical health services include non certified health workers, traditional healers, walking merchants, and markets.
[105] Traditional/non-medical health services include non certified health workers, traditional healers, walking merchants, and markets.
[106] Only five caregivers of children 0-6 months reported having sought information or treatment advice about a recent episode of childhood diarrhea. Due to the limited data from caregivers of children 0-6 months, the information shown for children 0-6 months in this table should not be extrapolated to be illustrative of general care seeking behaviors among caregivers of children 0-6 months in the Title II program area.

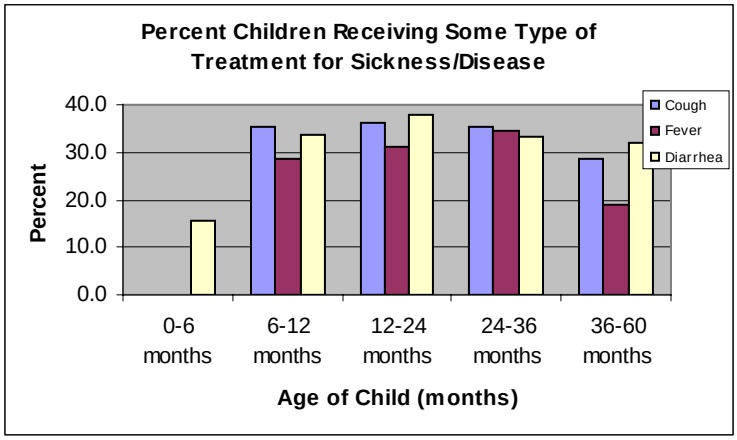
time, it is essential that Cooperating Sponsors continue to interface with health stations/clinics at the PA level, to effectively seize opportunities for disseminating health information and treatment advice for childhood illnesses.

The Cooperating Sponsors in Ethiopia might also consider including traditional providers of care among those targeted as recipients of information and guidance on recommended treatment protocols for common childhood illnesses and diseases. Because a substantial proportion of caregivers seek treatment advice from traditional, non-medical sources, information on appropriate treatment of childhood disease should be shared beyond health care workers within institutional medical facilities. Messages on the appropriate treatment of childhood illness should be disseminated widely, among institutional medical facilities and staff, as well as among non-institutional medical facilities, particularly, traditional health providers, and community members at-large.

Treatment Practices for Childhood Illness

Data showing the actual treatment given to children provide specific information on the frequency with which recommended treatment protocols are followed. Of those children having experienced cough, fever, or diarrhea, few children were reported to receive any sort of treatment[107] (figure 13.2). Among children 6 months to five years, 34.2 percent of those with a cough, 29.2 percent of those with fever, and 35.0 percent of those with diarrhea received treatment. Among children 0-6 months, only 15.7 percent received any type of treatment for diarrhea[108].

Figure 13.2



Data on the type of treatment provided to the affected child are shown below. The data are separated according to the specific illness of the child in order to examine, when possible, the extent to which appropriate treatment protocols are followed for the type of illness present.

[107] This data is in response to the question, "Did you give the child something for his/her illness (cough, fever, or diarrhea)?" The above data therefore specify only if some sort of treatment was provided to the sick/ill child. They do not account for if the treatment provided is appropriate for the sickness/illness of the child.
[108] Data on treatment provided for cough and/or fever are not available for children 0-6 months.

Fever. When a child presents with a fever in a malaria endemic area, screening for both malaria and pneumonia is recommended. Appropriate malaria treatment recommends that a full course of anti-malarials be given, along with continued feeding and increased fluids during illness and continued fluids and feeding immediately after illness. Should malaria be diagnosed, appropriate treatment protocol would ask that management of pneumonia also be considered if the child has cough or difficulty breathing, and fast breathing or chest in-drawing. Treating only malaria may result in death from pneumonia (USAID 2000).

The Ethiopia baseline data indicate that aspirin, along with Tylenol (acetaminophen), paracetamol, and analgesics, are the most common treatment given for cases of childhood fever. These data, however, should be interpreted cautiously. While acetaminophen can be an appropriate treatment for cases of childhood fever not caused by malaria, provision of aspirin is not an appropriate treatment for any type of fever. In fact, provision of aspirin to children under 19 years is never recommended, due to the risk of the child acquiring Reye's syndrome. Unfortunately, the coding used in the forms used for data collection did not differentiate between aspirin and other pill medications such as acetaminophen. As a result, there is not sufficient information available to disaggregate the percent of caregivers having provided acetaminophen from the percent of caregivers having provided aspirin to the child. No real conclusions about correct/incorrect treatment practices relating to pill type can therefore be made.

Conclusions about other treatment types provided for childhood fever are also difficult. Although 11 percent of children were given chloroquine for treatment of a fever, it is difficult to know if this reflects a correct treatment practice, due to a lack of data on the specific circumstances of the child presenting with fever.

Table 13.9 Treatment Provided for Childhood Fever (%)[109]

Age of Child (months)	Chloroquine (%)	Aspirin, Tylenol, Paracetamol, Analgesics	Cold Sponge	Overdress the Child	Other[110]
6-12	15.0	69.2	2.6	7.7	20.5
12-24	10.4	54.5	6.5	5.2	32.5
24-36	10.4	53.2	6.5	7.8	28.6
36-60	9.7	48.4	0	12.9	32.3
Total					
6-60	**11.1**	**55.8**	**4.9**	**7.6**	**29.0**

Cough. The appropriate treatment protocol for a cough is dependent on the nature of the cough. In cases of common colds, the appropriate treatment for an associated cough can include cough syrup, a treatment often provided to children in the Title II area (table 13.10). Treatment with tea or the traditional herbal therapy might also be appropriate. If, on the other hand, the cough is

[109] These treatment practices are for those children reported to have a fever in the two weeks prior to data collection who also received some sort of treatment for that fever. This question allowed for multiple responses to be mentioned by the respondents. For tabulation purposes, each category is treated separately, so that the percentage cited reflects the percent of total cases indicating the category of interest as a response.
[110] Data are not available as to what these "other" practices are.

associated with pneumonia, the appropriate treatment protocol would be more specific, and would include treatment with oral antibiotics (USAID 2000). In such cases, the possibility of a simultaneous infection with malaria should be considered, and treated accordingly (USAID 2000).

Table 13.10 Treatment Provided for Childhood Cough (percent)[111]

Age of Child (months)	Antibiotic Pill	Antibiotic Syrup	Antibiotic Injection	Cough Syrup	Tea or Trade's Herbal Remedy[112]	Other [113]
6-12	26.0	51.0	16.3	8.2	16.3	2.0
12-24	18.4	38.0	10.0	12.0	21.0	7.0
24-36	21.8	40.7	14.0	7.0	26.7	11.6
36-60	19.1	24.4	4.4	8.9	42.2	17.8
Total						
6-60	20.9	38.9	11.4	9.3	25.4	9.3

Diarrhea. Similarly, appropriate treatment of diarrheal disease depends, in part, on the type of diarrhea present. There are three main types of diarrheal disease that affect children in developing countries: 1) acute watery diarrhea, 2) dysentery, and 3) persistent diarrhea. A child affected with any of these types of diarrhea should receive Oral Rehydration Salts (ORS) for the prevention and treatment of dehydration. It is important also that continued feeding and increased fluid intake are provided during an episode of any type of diarrhea. In addition, treatment by antibiotic may be required for dysentery, and dietary adjustments, such as reduced lactose intake, may be helpful in the case of persistent diarrhea (USAID 2000).

Data on the type of diarrhea experienced are not available. The treatment data below are therefore for non-specific cases of diarrhea. The data indicate that among children 6 months to 5 years, less than one in three children received the recommended treatment of ORS for diarrhea. Moreover, only one in four children received increased fluid intake[114], and just one in five children received continued feeding[115] during a recent diarrhea episode. Taken together, only 1.4 percent of children 6 months to 5 years received all three elements of appropriate treatment for diarrhea (table 13.11) [116].

[111] These treatment practices are for those children reported to have a coughing episode in the two weeks prior to data collection who also received some sort of treatment for that cough. This question allowed for multiple responses to be mentioned by the respondents. For tabulation purposes, each category is treated separately, so that the percentage cited reflects the percent of total cases indicating the category of interest as a response.
[112] The traditional herbal treatment is defined as a domestic treatment, infusion, traditional medicine based on plants.
[113] Data are not available as to what these "other" practices are.
[114] "Increased fluid intake" has been defined here as giving the child more liquid during the diarrhea episode.
[115] "Continued feeding" has been defined here as giving the child about the same quantity or more to eat during the diarrhea episode.
[116] The definition for having applied recommended treatment for diarrhea involves three components for treating diarrhea, 1) Providing ORS to the child during diarrhea 2) Providing increased fluids to the child during diarrhea and 3) Providing continued feeding to the child during diarrhea. All three of these behaviors must have been practiced for the treatment applied during the diarrhea episode to be considered as "recommended."

Table 13.11 Feeding Practices and Treatment Provided During Diarrhea (%)

Age of Child (months)	ORS Provided	Increased Fluids Provided	Continued Feeding Provided	Recommended Treatment
0-6[117]	0.0	Not available[118]	Not available[119]	Not available
6-12	14.3	15.3	25.5	2.0
12-24	12.5	25.6	16.1	0.0
24-36	10.1	27.5	30.1	0.5
36-60	5.1	27.5	19.3	0.0
Total				
6-60	111	24.8	22.5	0.5

The use of ORS as treatment for childhood diarrhea has demonstrably reduced diarrhea case fatality rates in developing countries (USAID 2000), yet only 11 percent of children (6-60 months) in Ethiopia with a recent episode of diarrhea received ORS. The results in table 13.12 indicate a slight relationship between distance to ORS supply and use of ORS. Given that distance may be a determining factor for application of ORS in treatment for diarrhea, community accessibility to ORS should be explored. Moreover, gaps in knowledge and/or behavior related to ORS as a treatment for diarrhea should be addressed. These gaps may be at the household, community health center/health post, public health station or medical facility level. The need for Cooperating Sponsors to increase the accessibility of ORS while continuing to educate caregivers on the benefits of ORS for treatment of childhood diarrhea is thus indicated. Similar efforts to provide education may be warranted at all places where treatment for diarrhea is practiced or advice for treatment of diarrhea is sought, including the traditional health care sector.

[117] Only eight caregivers of children 0-6 months reported to have provided treatment to the child for a recent episode of diarrhea. Of these, only six respondents answered questions relating to the type of treatment provided. Due to the limited data from caregivers of children 0-6 months, the information shown for those children here should not be seen to represent general care seeking behaviors among caregivers of children 0-6 months in the Title II program area.

[118] Data on fluid intake during diarrhea were not collected for children 0-6 months, due to the potential for unreliable data to have been collected. Conventionally, data on fluid intake for children of this age are collected in response to the question: "I would like to know how much liquid the child received during his/her diarrhea. Have you given him/her less to drink than usual, about the same amount or more than usual?" The wording of the question, however, leaves room for inaccurate feeding practices to be considered as correct. Because the exact nature of the liquids provided to the child is not known, it is possible that the question erroneously categorizes inappropriate feeding practices as correct. That is, while some respondents report having provided more liquids than usual when having increased the amount of breast milk given to the child, other respondents may have also reported having provided more liquids than usual when providing tea or water (incorrect practices) to the child of exclusive breastfeeding age.

[119] Data on continued feeding during diarrhea were not collected for children 0-6 months, due to the potential for unreliable data to have been collected. Conventionally, data on continued feeding for children of this age are collected in response to the question: "When the child had diarrhea, did you give him/her less to eat than usual, about the same amount, more than usual, or nothing at all to eat?" During the period of exclusive breastfeeding, however, the definition of food may not be the same among all survey respondents. It is possible for instance that not all respondents would consider providing breast milk as providing food to the child.

Table 13.12 Relationship between ORS Provided for Treatment of Childhood Diarrhea and Distance to ORS Supply

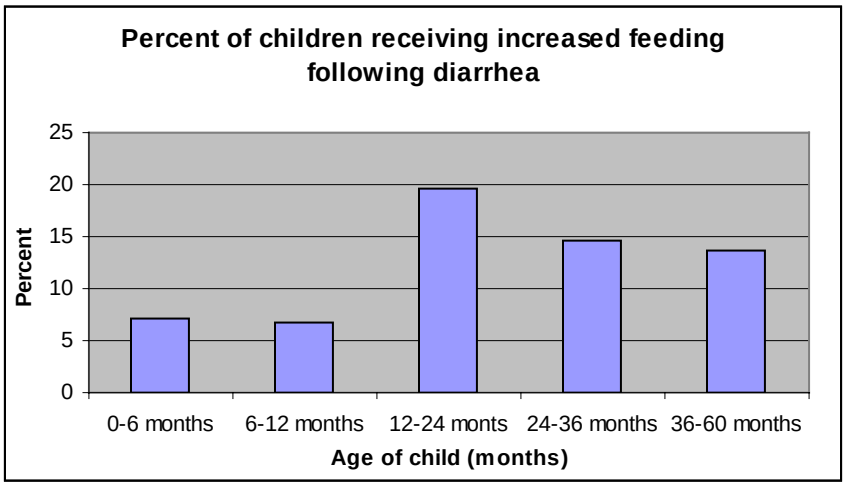
Mean Distance to Closest ORS Supply (minutes)	ORS Provided as Part of Treatment for Diarrhea
62.7	ORS provided
126.0	ORS not provided
T value, P value	1.593, 0.117

Diarrheal cases among children 0-6 months are also of concern in Ethiopia. Children in that age group, if exclusively breastfed, should have less exposure to pathogens, yet they may still get infected due to environmental contamination. The appropriate treatment protocol for exclusively breastfed children includes providing increased breastfeeding to the affected child. In cases of moderate or severe diarrhea, the advice of a trained health worker should be sought. If the infant appears dehydrated, administration of ORS, in addition to continued breastfeeding, may be recommended (LINKAGES 2002). Fluids other than breast milk and ORS should not be given, unless recommended by a trained health professional, and exclusive breastfeeding should recommence once the diarrhea has ceased (Dialogue on Diarrhoea Online 1992). The Ethiopia Title II baseline data indicate that no children less than six months received the appropriate ORS treatment for diarrhea (table 13.11). Similarly, few mothers of children 0-6 months reported appropriate feeding practices (i.e. increased breastfeeding) during the episode of child diarrhea. Whereas less than twenty percent of mothers reported giving increased breast milk, nearly half provided a bit less (25.6%), much less (18.6%), or stopped giving (2.3%) breast milk during the diarrheal episode.

During episodes of diarrhea, the growth of a child may falter, due to the child's impaired ability to absorb and utilize nutrients. The period following recovery from diarrhea represents an important opportunity during which convalescence, or 'catch-up growth' can occur. Once diarrhea has ceased, increased feeding is therefore recommended, and may enable a child to return to his/her prior health and nutrition status, rather than to remain at a deteriorated level. While increased feeding following illness is a recommended practice for children of all ages, the potential for catch up growth after illness is best for children under two years. Among children 6-24 months in the Title II Program area, less than 20 percent of children 12-24 months and only 6.7 percent of children 6-12 months received increased feeding following the diarrhea episode (figure 13.3). Similarly, only 7.1 percent of children 0-6 months received increased feeing (i.e. breast milk[120]) after diarrhea. Messages emphasizing the importance of increased feeding following episodes of childhood illness are therefore likely to offer benefits for child health and nutrition outcomes in Ethiopia. The audience for these messages could be selected broadly. There may be a need to disseminate these messages not only to child caregivers, but also to health workers who interact with caregivers during health and nutrition counseling or treatment sessions.

[120] The feeding recommendation for children 0-6 months is that exclusive breastfeeding should recommence following diarrhea, and should be provided in increased quantity. For the purpose of this survey, we collected information to report only if after the episode of diarrhea increased breast milk was provided (in comparison to usual).

Figure 13.3[121]



Hygiene, Water and Sanitation

To some extent, childhood illness and disease can be reduced with the undertaking of certain preventative health practices. Many of these health practices have already been discussed. These include appropriate infant and child feeding practices, and adequate health service delivery, such as childhood immunization against vaccine preventable diseases. Behaviors related to hygiene, safe water, and sanitation are also important for the prevention of illness and disease, and should not be overlooked.

As already discussed in Chapter 6, access to protected water sources and adequate sanitation is limited for most households in Ethiopia. Among households having children under five years, only 3.3 percent of households have access to a protected/covered water source and only 2.3 percent of households have access to adequate sanitation facilities. Nearly 98 percent of households lack access to both a protected water source and a toilet.

The state of caregiver knowledge about appropriate hygiene, water, and sanitation practices provide complementary information for program planning[122]. The Ethiopia baseline survey collected data on caregivers' knowledge of methods to prevent against childhood diarrhea. The results indicate a fair amount of awareness about the importance of hand washing[123] (figure 13.4). Nearly two out of three caregivers reported washing their hands, and more than one half of caregivers reported washing their child's hands in order to protect against child diarrhea. The importance of washing hands before preparing food (91.4%), and before feeding the child (81.9%) was recognized by most caregivers (table 13.13). Caregivers also commonly reported keeping the house clean and washing dishes/utensils as relevant practices for preventing child

[121] Note the data in this figure reflect different things. For children 6-60 months, it reflect whether increased feeding was provided. Here the type of food given is unspecified. For children 0-6 months, the data reflect if increased breast milk was provided following diarrhea.
[122] These questions were asked both of the caregiver for children 6 months and older, and of the caregiver for children 0-6 months. The data tabulated here represents information collected in the module relating to the reference child between the ages of 6 and 60 months.
[123] This question allowed the respondent multiple responses. For tabulation purposes, each category is treated separately, so the percentage cited reflects the percent of total cases indicating the category of interest as a response.

diarrhea (54.3% and 37.0%, respectively). While these results give positive indications about caregiver awareness on hygiene related issues, some important gaps in caregiver hygiene knowledge and practice can also be identified. Few respondents, for example, reported purification of drinking water (12.3%) or washing fruits and vegetables (4.6%) as a method to protect against diarrhea. In addition, less than half of the respondents reported that hands should be washed after going to the toilet and only 12.4 percent reported that hands should be washed after changing the child's diapers (table 13.13). Moreover, when asked to demonstrate hand washing behavior, only ten percent of caregivers were reported to wash hands correctly[124].

Figure 13.4[125]

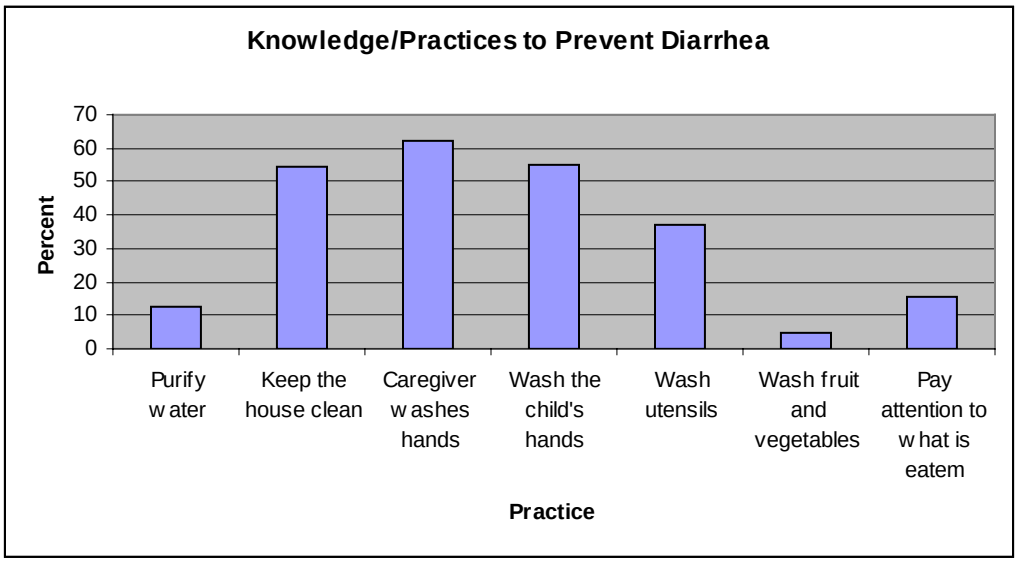


Table 13.13 Caregiver report on when hands should be washed[126]

Knowledge about when hands should be washed	Percent of respondents[127]
Before Preparing Food	91.4
Before Feeding the Child/Before Eating	81.9
After Going to the Toilet	42.9
Before Breastfeeding	22.9
After Changing the Child's Diapers	12.4

In sum, household characteristics related to water and sanitation resources, along with the demonstrated level of knowledge and current hygienic practices of caregivers suggest potential areas for program attention. In particular, interventions to increase access to protected water

[124] Correct hand washing technique has been defined as involving four components: 1) the use of water 2) the use of soap 3) the washing of both hands and 4) scrubbing a minimum of three times.
[125] The percent of respondents reporting "other" in answer to this question was not tabulated, given that it is not possible to know if the "other" response represented a correct knowledge/practice.
[126] The percent of respondents reporting "other" in answer to this question was not tabulated, given that it is not possible to know if the "other" response represented a correct knowledge/practice.
[127] This question allowed for multiple responses to be mentioned by the respondent. For tabulation purposes, each category is treated separately, so that the percentage cited reflects the percent of total cases indicating the category of interest as a response.

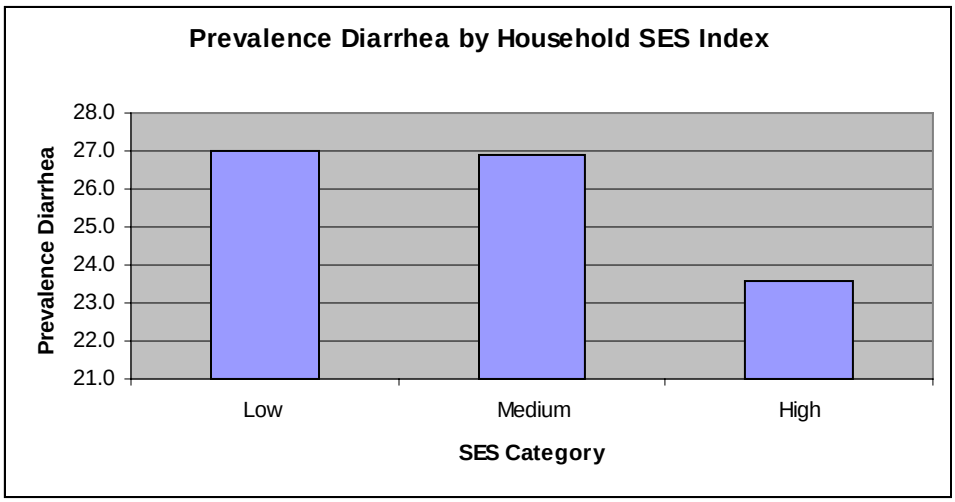
sources are indicated. Improvements in sanitation hardware, such as improved access to latrines, are also desirable and may help reduce the risk for childhood illness and disease. In addition, instructive messages on proper hand washing technique would be a recommended area for attention. Distribution of soap to target households would be a useful complementary activity. The results provided by bivariate and regression analyses will be particularly important as they can provide an indication of the extent to which programmatic attention in these areas may present an opportunity for better child nutrition and child health outcomes in Ethiopia.

Bivariate Analyses: Hygiene, Water and Sanitation & Prevalence of Diarrhea

Bivariate analyses provide a preliminary indication of the environmental and behavioral factors that may be related to diarrhea. The results inform about potential opportunities for intervention that could facilitate an improvement in the frequency of childhood diarrhea. In undertaking the bivariate analyses, we hypothesized household wealth to be associated with the presence of diarrhea. In addition, we explored the relation of water and sanitation variables, and knowledge about appropriate hygiene and infant and child feeding practices with the outcome of child diarrhea. In general, children six months to five years were of focus in the analyses. However, only children 6-24 months were included in the analyses that tested the association between diarrhea and infant and child feeding practices.

Figure 13.5 shows the prevalence of diarrhea according to categories of household wealth. Given that positive child health and nutritional outcomes are often associated with factors related to socio-economic status, we expected to see a decreasing prevalence of diarrhea across low to high categories, for each of the indices explored. The results are as expected; the extent of the decrease across wealth categories is, however, slight, with a reduction of only 3.4 percentage points in the prevalence of diarrhea indicated between the high and low wealth categories. The relationship is not statistically significant (p= 0.126).

Figure 13.5



The results from bivariate analyses of household water and sanitation resources with the prevalence of child diarrhea are shown in table 13.14. While access to a protected water source

and to an adequate toilet each demonstrate a positive association with childhood diarrhea, so that a decreased prevalence in indicated for each group, neither of these relationships demonstrate statistical significance (p=0.544 and p=0.845, respectively). We believe the p values are higher than expected, due to the lack of differentiation the sample demonstrates for the water and sanitation variables. As discussed earlier, only 3.3 percent of households reported access to a protected/cover water source and only 2.3 percent of households reported access to adequate sanitation facilities. The influence of each of these variables on the frequency of child diarrhea will be more thoroughly explored by multi-variate logistic modeling, in Chapter 16.

Results from analyses related to knowledge and hygiene practices also show potentially important associations. For example, children of caregivers able to report two or more methods for preventing diarrhea showed a lower prevalence of diarrhea than those children of caregivers not knowing at least two methods for preventing diarrhea, and, similarly, the children of caregivers able to report two or more appropriate times for hand washing showed a lower prevalence of diarrhea than those children of caregivers not knowing at least two appropriate times for hand washing. A difference of around 3.5 percentage points in prevalence was indicated in each case, and while neither of these relationships is shown here as statistically significant, the findings do, nevertheless, highlight potential areas for CS intervention.

While our bivariate results do not indicate proper hand washing technique as related to a reduction in childhood diarrhea, this may again be due to the lack of variation in the sample for the determining factor of interest. As mentioned earlier, only 10 percent of all caregivers were reported to demonstrate correct hand washing technique.

Table 13.14 Relationship between Water, Sanitation, Hygiene & Diarrhea

Household Characteristic/ Caregiver Knowledge	Prevalence Diarrhea (%)
a. Water source	
1.Protected water source	24.1
2.Unprotected water source	25.7
P value	P=0.739
b. Distance to water source	
1. Less than half an hour	26.1
2. More than half an hour	25.0
P value	P=0.544
c. Sanitation facility	
1.Household has a latrine/toilet	24.6
2.Household does not have a latrine/toilet	25.7
P value	P=0.845
d. Knowledge about how to prevent diarrhea	
1.Knows 2 or more methods	25.6
2.Knows less than 2 methods	29.2
P value	P=0.076
e. Knowledge about when to wash hands	
1. Knows 2or more times when to wash	25.4

Household Characteristic/ Caregiver Knowledge	Prevalence Diarrhea (%)
hands	
2. Knows less than 2times when to wash hands	28.8
P value	P=0.249
f. Hand washing technique	
1. Correct hand washing technique	27.8
2. Incorrect hand washing technique	25.7
P value	P=0.479

Certain infant and child feeding practices are also known as related to childhood diarrhea. Breast milk, for example, provides important anti-bacterial agents to the breastfed child, and, can, in this way, provide some protection against infectious agents that can cause diarrhea. Bottle use, on the other hand, can facilitate the spread of bacteria to the child, thereby increasing a bottle fed child's risk for acquiring diarrhea. Each of these feeding practices was studied among children 6-24 months in order to explore potential associations with the prevalence of diarrhea in Ethiopia, however, neither continued breastfeeding nor bottle use demonstrated the expected relationship with childhood diarrhea (table 13.15). While these results are surprising, it is possible that the bivariate analysis is confounded by other factors not considered, such as age of child, household socio-economic status, or education level of the caregiver. Potential interactive effects between feeding variables and sanitation conditions may also account for the lack of bivariate relationship between feeding practices and diarrhea.

Table 13.15 Relationship between Infant and Child Feeding Practices & Diarrhea

Feeding Practice	Prevalence Diarrhea (%)
a. Continued breast feeding	
1. Still breastfed	33.5
2. Not breastfed	25.2
P value	P=0.062
b. Bottle use	
1. No bottle use	34.7
2. Bottle use	26.5
P value	P=0.013

Key Findings and Program Implications

Data on preventative child health and treatment practices indicate important gaps in caregiver knowledge/behavior. In order to reduce the prevalence of childhood illness as well as to improve recoveries from childhood illness, certain interventions related to child health and treatment practices are suggested. Recommended areas of focus are summarized below.

- Immunization coverage
- Vitamin A supplementation coverage

- Appropriate comprehensive treatment for childhood diarrhea, that is, providing ORS, increased fluids, and continued feeding during diarrhea; a focus on the appropriate treatment of diarrhea for children 0-6 months of age is also recommended.
- Feeding practices following childhood diarrhea (and other episodes of sickness), specifically, the need to increase the amount of food provided to the child in order to facilitate catch-up growth

In way of potential interventions, Cooperating Sponsors in Ethiopia might consider efforts to improve the water and sanitation resources of households. Appropriate agriculture and food based approaches to address children's health and nutritional status are also needed. Continued efforts to promote dietary diversity are needed, and home gardening of high nutrient foods is suggested as a potential area of complementary intervention. Providing increased information on recommended child health and treatment practices is also suggested, with wide dissemination of the messages necessary. Child caregivers and influential household members, traditional health providers, as well as health workers in both institutional and non-institutional health facilities should be among the target groups of focus. To be effective, the behavior change and educational messages need to be designed appropriately for the target group. Variations of specific messages may therefore need to be developed so that each target group is addressed effectively.

In addition, certain preventative health practices, such as childhood immunization and vitamin A supplementation may be influenced by complementary efforts for increased caregiver knowledge and increased outreach services. As already discussed, the vaccination rates in the Title II program area are very low, both among children 12-23 months of age, and even more so, among children 24-60 months. Children having not received the recommended full course of childhood vaccinations are at increased risk for mortality. In fact, the risk for increased rates of child mortality in the area is likely, given the high rates of child malnutrition, morbidity (cough, fever, diarrhea), and vitamin A deficiency (as indicated by night blindness) documented by the Title II Baseline Survey. In such a context, the impact of a measles outbreak could be devastating, with far reaching consequences for child mortality.

To prevent such a situation, Cooperating Sponsors should devote efforts to increasing childhood vaccination rates both among children of the target age group, as well as among those older children having not yet received the proper course of vaccinations. Cooperating Sponsors in Ethiopia would be advised to examine those communities at great distance from immunization services. Program efforts to provide immunization services in closer proximity to these communities, in tandem with educational messages about the importance of childhood immunization, may help to increase immunization, as well as vitamin A supplementation coverage rates.

Chapter Fourteen. Child Care

The health and nutrition data presented so far relate most specifically to two of the three underlying causes of malnutrition: 1) Inadequate access to food and 2) Insufficient health services. Data related to the third underlying cause of malnutrition, inadequate care, are described below.

Care refers to caregiver practices that support a child's need for sufficient and adequate food, health care, stimulation, and emotional support. In a more specific definition, Engle has defined care practices as "proximal aspects of the environment that are primarily social, and influence children's growth and their development" (Engle 1999). Using this definition, care practices include a wide spectrum of behaviors related to outcomes of child survival, health, and nutrition. Many of these, such as breastfeeding, complementary feeding, and child health practices, have been addressed in earlier chapters. Other care practices, such as maternal and neonatal care are addressed in forthcoming chapters. The focus of this chapter is on care resources, that is, the resources that support and enable the practice of caring behaviors.

A discussion on care practices will not adequately address the determining factors of child health and nutrition status if it neglects the resources available for performing these practices. The applied conceptual framework (figure 11.1) illustrates how resources for providing care and caring practices relate to child health and nutrition outcomes. The mechanism operates so that the resources available for care provision can affect the extent to which caring behaviors are implemented. These caring behaviors and the way in which they are performed are important; as Engle describes, "[care] practices translate food security and health resources into a child's well being" (Engle 1999).

Identity of the Child Caregiver

The identity of the primary and secondary child caregiver for children 6-60 months is shown in tables 14.1 and 14.2. The identity of the caregiver for children 0-24 months is particularly important. At this age, breast milk is an important source of nutrients and anti-infective properties for the child, and often can only be received from the child's biologic mother, unless there is another lactating woman accessible to the child. While nearly all children 6-24 months have their mother as primary caregiver, only 80.9 percent of children 0-6 months receive care primarily from their mother[128]. With one out of five children between the ages of 0 and 6 months reported to <u>not</u> receive care primarily from their mother, concerns are raised about the

[128] The low percent of children 0-6 months with their mother indicated as primary caregiver was an unexpected finding. We further explored the data to explain this finding. It was hypothesized that first time mothers or younger mothers might be less likely, by tradition, to be the primary caretaker of young children. Our analyses, however, did not support this hypothesis: while first time mothers are less frequently reported as the primary caregiver for children 0-6 months, only 81.3 percent of mothers having previous children were reported as the primary caregiver of children 0-6 months. Our analyses also showed only a small difference (less than one year) between the average age of mother indicated as primary caregiver of children 0-6 months and those who were not. Some further contextual information can, at least, be provided: for example, in those cases for which the mother is not reported as the primary caretaker, it is most often a sibling of the child who is indicated as playing this role, which could be due to the mother working away from home. Furthermore, it should be reminded that the results for children 0-6 months are based on a convenience sample; the data are not statistically representative.

extent to which recommended feeding practices, namely, exclusively breastfeeding, can be carried out for this group of children.

Table 14.1 Identity of the Primary Child Caregiver (%)

Age of Child (mo)	Mom	Dad	Aunt	Grand mother	Grand father	Sister or Brother	Other
0-6	80.9	0.0	0.7	0.3	0.7	16.9	1.3
6-12	97.9	0.0	0.0	0.9	0.3	0.9	0.0
12-24	96.2	0.0	0.1	2.6	0.1	0.6	0.3
24-36	94.9	0.3	0.4	2.7	0.0	1.5	0.3
36-60	92.9	0.3	0.6	4.2	0.3	1.2	0.6
Total							
6-60	95.2	0.2	0.3	2.8	0.2	1.1	0.3

Concerns about the availability of the mother to provide breast milk are further informed by examining the identity of the secondary caregiver of the child (table 14.2). Among the 3.2 percent of children 6-24 months without their mother as primary caregiver, 36.1 percent have their mother as secondary caregiver. This implies that only two percent of children 6-24 months are without their mother as the primary or a secondary caregiver. The data are less positive for children of exclusive breastfeeding age. Of those 19.1 percent of children less than six months without their mother as the primary caregiver, only 23.7 percent of the children have their mother as a secondary caregiver. Thus, as many as five percent of children less than six months of age do not receive care, neither primarily nor secondarily, from their mother. It would seem unlikely that these children are in a situation allowing them to receive breast milk regularly[129].

[129]Unfortunately, data are not available to indicate the whereabouts or circumstances of those mothers who are not caregivers to their children. It is possible that in many cases she is off to earn income through petty trading activities or agricultural production, in which case, this absence of the mother may be partly compensated by an increase in household income. It is possible also that the mother is not present in the household because the child has been sent away to live with his/her grandmother or other relatives, or alternatively, because the mother is recently deceased.

Table 14.2 Identity of the Secondary Child Caregiver[130]

Age of Child (months)	Mom (%)	Dad (%)	Aunt (%)	Grand mother (%)	Grand father (%)	Sister or Brother (%)	Other (%)
0-6	23.7	NA[131]	6.3	21.6	1.5	21.6	9.7
6-12	71.4	13.0	3.9	30.7	1.8	38.5	7.2
12-24	28.6	15.9	3.2	27.2	2.8	50.4	8.7
24-36	28.9	17.7	3.2	28.9	2.1	49.8	7.3
36-60	27.1	18.6	3.2	25.7	4.3	57.7	7.7
Total							
6-60	30.6	16.7	3.3	27.8	2.8	50.6	7.8

The identity of the child caregiver is useful not only to understand if the mother is able to provide breast milk to the child, but also to appropriately target child health and nutrition messages. The data from the Title II Joint PVO Baseline Survey suggest that the grandmother, father, and siblings of the child, in addition to the mother, play an influential role in the provision of childcare and the care practices implemented. Including these individuals among those targeted for behavior change and communication messages could represent an opportunity for knowledge about appropriate health and nutrition practices to be further influenced and more commonly implemented.

The data from Ethiopia indicate that primary caregivers are responsible for providing care for the child nearly all seven days of the week. On average, primary caregivers spend an average of 6.12 days per week as the caregiver for children 6 months to 5 years. Among younger children, the average number of days per week for the primary caregiver is slightly higher. Primary caregivers are reported to provide care for children of exclusive breastfeeding age (0-6 months) an average of 6.26 days per week and for children 6-12 months an average of 6.33 days per week.

Resources Available to Provide Care Practices

Beyond the identity of the child caregiver and the amount of time per week spent with the child by the caregiver, demographic characteristics of the primary care provider can give an indication of the resources available for provision of care to the child. Caregiver variables like age, employment status, and education level can, for example, affect the capacity of the caregiver to provide appropriate care to the child. Table 14.3 below shows descriptive summary data relating to these demographic aspects. The data reflect the characteristics of mothers who are the primary caregiver of the reference child.

[130] Data on the secondary caregivers of the child reflect the survey respondent's answer to the question: "If this person (the primary caregiver) is absent, who takes care of the child?" The values shown in table 14.2 are tabulated among the sub-set of children whose primary caretaker was not already indicated to be that individual. It should be noted that this question allowed for multiple response. For analysis purposes, each category is treated separately, so that the percentage cited reflects the percent of the total sub-sample indicating the category of interest as a response.

[131] The percent of children 0-6 months having either their father or "other" reported as a secondary caregiver cannot be tabulated accurately, due to a typing error that occurred on the final questionnaire forms.

Table 14.3 Summary Table of Demographic Characteristics

Demographic Characteristic		Percent	
Mother's age (mean age in years)		30.4	
Mother's civil status			
	Married	91.6	
	Single	1.0	
	Divorced, Separated	4.9	
	Widowed	2.5	
Female headed household		7.6	
Households with 2 or more children under five		47.3	
Mother's education	None[132]	89.0	
	1-3 years primary	5.9	
	4 years primary or beyond	5.1	
Maternal Literacy	Yes, Literate	13.4	
Mother's Occupation, Primary and Secondary		1°	2°
	Cultivator	15.1	25.0
	Herding	1.1	9.0
	Pastoralist	0.0	0.8
	Other paid work	5.7	17.7
	Unpaid Domestic Work	69.3	22.6
	Other unpaid work	6.0	24.9
	Ill/Disabilitated	0.1	0.0
	Student	0.4	0.0
	No occupation	2.3	0.0

The mean age of mothers with children less than 5 years is thirty years (table 14.3). While this age may seem relatively high for a developing country context, it should be noted that this mean age does not reflect age at time of first birth, or even the mother's age at the time of birth of the reference child. Rather, the age reported above indicates the current age of the mother of the reference child under five years of age. As a result, without undertaking regression analysis, in which the age of the child is accounted for, few conclusions, other than to say that the age does not appear markedly low, can be made.

The employment status of the mother caregiver can have positive and negative consequences for the mother's capacity to provide care to her child. Employed mothers may have greater access to resources, enhanced decision-making ability, and greater influence in the household in relation to their unemployed counterparts. The potential drawback to maternal employment is related to the likely decrease in her availability to provide care for her child. Women working outside of the home may be away from their children for long periods of time. As a result, the capacity of the mother to provide care to her child may be compromised. The reported primary and secondary[133] occupation of mother caregivers are shown in table 14.3. The results indicate that

[132] For the purpose of this report, traditional or religious schooling, without any type of formal education having been received, is categorized as "no education".
[133] Not all women had a secondary occupation indicated.

as many 22.3 percent of women may be working away from the home[134] and therefore could be separated from their children while at work. Unfortunately, no definitive conclusion can be made, as specific data describing the extent to which mothers bring their children to work are not available.

Bivariate Analyses: Resources for Providing Care Practices and Care Practices

To better understand how resources for providing care translate into the care provided to children, bivariate analyses were undertaken. The bivariate analyses in this Chapter are for those households in which the mother is the caregiver of the child. Five indicators of care resources are hypothesized as related to child caring practices. These are: 1) household wealth; 2) education level of the mother; 3) status of the mother in the household[135]; 4) household type[136]; and 5) the number of children in the household[137]. The caring behaviors studied as outcomes of interest are those related to: 1) infant and child feeding practices and 2) child health practices. Bivariate analyses relating to feeding practices have been undertaken for children 6-24 months[138]; those bivariate analyses relating to child health practices have been studied for children 6-60 months. As expected, several variables describing the resources available for care are associated with behaviors related to infant and child feeding practices and child health care seeking and treatment practices.

Relationship of Care Resources to Infant and Child Feeding Practices

Four infant and child feeding practices were studied as outcomes of focus: 1) continued breastfeeding, 2) provided recommended minimum feeding frequency, 3) no use of bottle, and 4) dietary diversity (sum of food groups received by 24 hour recall). Results from the bivariate analyses show household wealth to be related to none of the feeding practices tested (figures 14.1, 14.2). This result is not surprising given the lack of association demonstrated earlier between household wealth and the nutritional status of children (see Chapter 12). Moreover, many of the positive feeding practices explored here are known to be more common among households with fewer resources. The use of bottle, as a negative feeding practice, is, for example, almost always more frequent among urban or 'wealthier' households[139]. Similarly, the practice of continued breastfeeding is sometimes seen more frequently among households with fewer financial resources[140]. The practice of providing the recommended number of daily feeds

[134] Included in this 22.3 percent are women who reported their primary occupation as cultivators, herders, other paid work, or as a student.

[135] The status of the woman in the household has been defined by whether the mother caregiver is indicated to have an influential role in seeking health care for a sick child. This is assessed from data collected in response to the question: "When your child or one of your children is seriously ill, who decides to bring the child to receive medical treatment?"

[136] Throughout this report, type of household refers to whether the household is female- or male-headed.

[137] For bivariate analyses, the association between having 1or 2 children as opposed to having 3 or more children less than five years in a household are explored in relation to the outcome variables of interest.

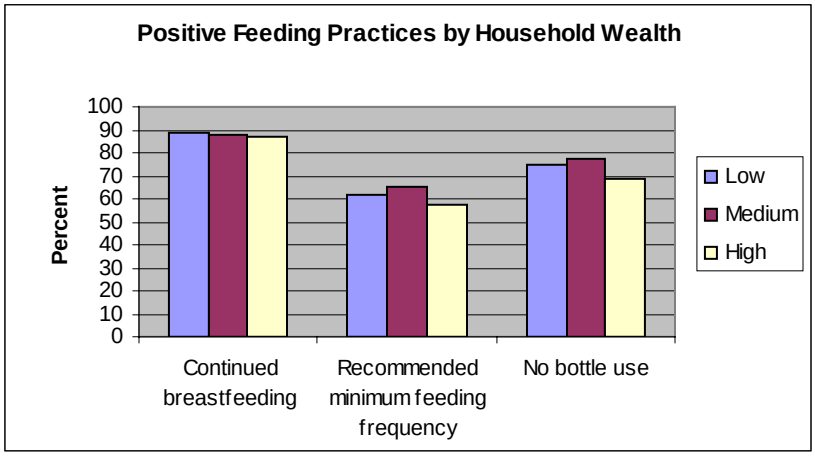
[138] The exception to this is food group diversity, which has been explored both for children of breastfeeding age (6-24 months) as well as for children of non-breastfeeding age (24-60 months).

[139] The results from the Title II Joint Baseline Survey in Haiti (2002) indicated a trend similar to that shown in Ethiopia. Among the low, medium, and high household wealth categories in Haiti, the percent of mother caregivers offering a bottle to their child (6-24 months) was reported as 7.0, 9.0 and 17.0 percent, respectively (Bergeron, G and Deitchler, M 2003).

[140] The Haiti Baseline Survey showed similar results to Ethiopia on this point also. Whereas in Ethiopia, a one percentage point decrease is shown in the practice of continued breastfeeding among the low (88.3%) vs. high (87.3%) SES households, in Haiti, a two percentage point decrease was shown in the practice of continued breastfeeding among the low (70%) vs. high (68%) SES households (Bergeron, G and Deitchler M 2003).

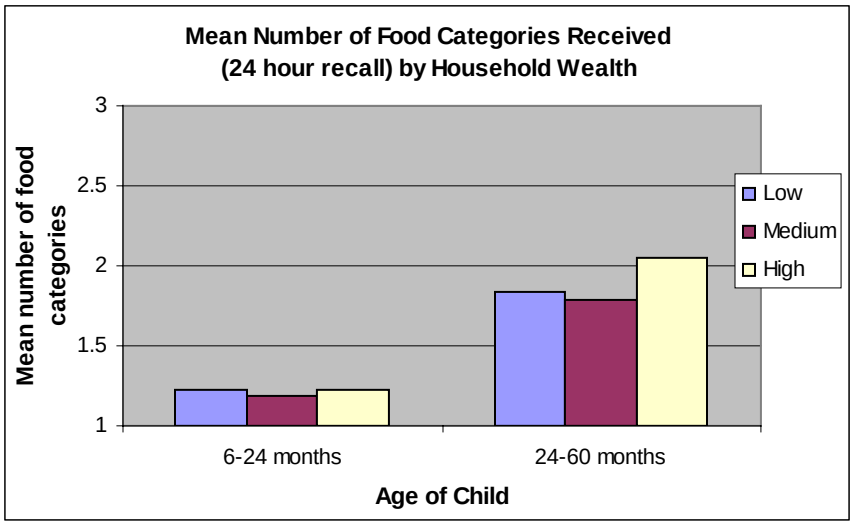
might, on the other hand, be expected to occur more frequently among 'wealthier' households. In this case, the lack of relationship demonstrated is difficult to understand from bivariate analyses alone.

Figure 14.1



In most situations, the relationship between household wealth and dietary diversity would be expected to demonstrate a strong linear association, such that children in 'wealthier' households receive more diverse food categories in their daily diet. This relationship is demonstrated among children 24-60 months. However, because of the lack of differentiation in the total number of food categories children are receiving in the Title II Program area in Ethiopia (see Chapter 12), no real difference in mean number of food categories received would be expected to be seen among younger children.

Figure 14.2



Other care resources, such as, maternal literacy, the status of the mother in the household, the number of children in the household, and the household type are indicated to more strongly

influence the ability of caregivers in Ethiopia to follow recommended infant and child feeding practices. The results of these analyses are shown in table 14.4 and discussed in detail below.

In general, child health and nutrition outcomes relate to the education level of the mother, such that higher maternal education is associated with caregiving behaviors that support good health and nutrition outcomes. The data from Ethiopia follow this general pattern. As shown in table 14.4, literate mothers are more likely not to use a bottle for infant and child feeding, and also tend to provide a higher number of food groups to children of complementary feeding age; yet, neither of these relationships demonstrates statistical significance at $p<0.05$. Statistical significance is, on the other hand, indicated for the relationship between maternal literacy and dietary diversity for older children. Whereas illiterate mothers provide an average of 1.82 food groups to in the daily diet, literate mothers provide an average of 2.40 food groups to children 24-60 months ($p=0.000$)

The composition of the household is a second demographic factor likely to influence the time availability and quality of care provided by the mother caregiver. Younger children require more attention and care, and therefore more time from the care provider. For each additional young child (e.g. under five years of age) in the household, the time availability of the mother caregiver must be shared, and can, in this way, present a challenge to the quality of care provided to each individual child. Following this reasoning, households having more than one child under five were seen as a possible predictor of compromised care, such that those mothers having more than one child under five might be disabled from providing optimal care to all of her children. Upon analyses with various care practice outcomes, the relationship between variables demonstrated these predicted associations. Household composition is significantly related to several of the infant and child feeding practices tested, and, for the other feeding practices, shows the trend expected. The findings indicate children more often receive continued breastfeeding ($p=0.145$), the recommended feeding frequency ($p=0.000$) and more diverse food groups (children 6-24 months, $p=0.136$; children 24-60 months, $p=0.001$)) if there are no other child under five years of age in the household. In addition, the data showed children are less likely to receive a bottle if he/she is the only child in the household ($p=0.000$).

We also hypothesized that several positive feeding practices would be influenced by the role of the woman in the household. We expected that mother caregivers in households headed by women would have more influence in making decisions related to child caring practices than might be available in households headed by men, and might therefore follow recommended feeding practices with greater frequency. The results from our bivariate analyses support this hypothesis; for every feeding practice tested, caregivers in female headed households tended to follow recommended feeding practices more often than caregivers in male headed households. Nearly all of the bivariate relationships tested were statistically significant. The only exceptions shown were for the practice of continued breastfeeding and providing the recommended number of daily complementary feeds which were only marginally significant ($p=0.061$ and $p=0.070$, respectively). Statistically significant differences of $p<0.05$ were, on the other hand, shown between male and female headed households for the practice of no bottle use, and the mean number food groups given both to children 6-24 months and 24-60 months of age. In the case of no bottle use, 90.8 percent of caregivers in female headed households reported having provided a bottle to the child, whereas 72.8 percent of caregivers in male headed households reported

having done so (p=0.001). With regard to dietary diversity, children 6-24 and 24-60 months in female headed households were shown to receive a respective average of 0.38 and 0.42 more food categories than children of the same age in male headed households (p=0.028 and p=0.002, respectively).

Women's status in the household, as indicated by her involvement/non-involvement in decisions about child health care, also showed a relationship with several infant and child feeding practices. Mothers reported to have a decision making role in child health care are more likely to practice continued breastfeeding, provide the recommended number of daily complementary feeds to the child, not use a bottle, and to provide the child with a higher number of food groups included in the daily diet (table 14.4). Not withstanding the relationship between woman's status in the household and the practice of continued breastfeeding, all of the above relationships show a statistically significant association with young child feeding practices. The size of the difference for adopting recommended feeding practices is, in several cases, substantial. For example, among mothers with a decision making role, 63.5 percent provide the child with the recommended daily feeding frequency, in comparison to 50.8 percent of mothers who lack a decision making role (p=0.006). Similarly, only 23.0 percent of mothers with a decision making role report the use of bottles for infant and child feeding, whereas among mothers without a decision making role, nearly half of children less than 24 months are reported to receive bottles during feeding (p=0.000). Dietary diversity shows a difference by women's status in the household, such that women with a decision making role shown to provide an average of about 0.25 more food groups in a young child's daily diet (p=0.026 for children 6-24 months).

Table 14.4 Relationship between Resources Available for Care and Infant/Child Feeding Practices

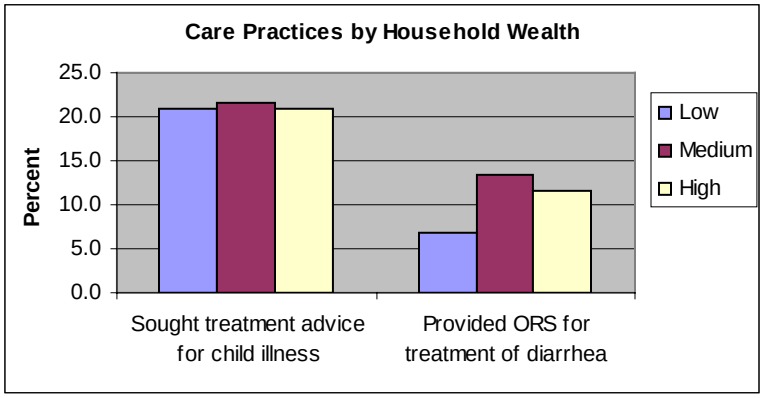
	Still breast-feeding (%)	Recommended feeding frequency (%)	No Bottle Use (%)	Mean number of food groups received (6-24mo) (No.)	Mean n of food groups received (24-60mo) (No.)
a. Education Level of the Mother					
1. Literate	89.4	55.6	80.4	1.37	2.40
2. Not Literate	87.4	62.5	73.0	1.19	1.82
P value	P=0.486	P=0.139	P=0.054	P=0.125	P=0.000
b. Status of Mother in the Household					
1. Mother has decision making role in seeking health care for child	88.6	63.5	77.0	1.25	1.91
2. Mother does not have decision making role in seeking health care for child	84.7	50.8	57.4	0.99	1.88
P value	P=0.154	P=0.006	P=0.000	P=0.026	P=0.748
c. Number of Children in the Household					

1. One child under 5 years	89.3	66.6	78.3	1.28	2.02
2. Two or more children under 5 years	86.3	56.2	69.9	1.15	1.75
P value	P=0.145	P=0.002	P=0.002	P=0.136	P=0.001
d. Household Type					
1. Female headed household	95.2	73.1	90.8	1.57	2.28
2. Male headed household	87.2	60.4	72.8	1.19	1.86
P value	P=0.061	P=0.070	P=0.001	P=0.028	P=0.002

Relationship of Care Resources to Child Health and Treatment Practices

Resources for providing care also translate into caring practices related to child health and treatment practices. The relationship of care resources to child health practices in Ethiopia were tested, the bivariate analyses focusing on two child health practices in particular: 1) if the caregiver sought advice when the child was ill[141]; and 2) if ORS was provided for cases of childhood diarrhea[142]. The results from bivariate analyses with household wealth did not demonstrate any statistically significant results (figure 14.3). A marked increase in the use of ORS is, however, evident when the middle and high SES households are compared against the low SES households.

Figure 14.3



Among the results shown in table 14.5, the most important relationships demonstrated are: 1) the positive association between maternal literacy and seeking treatment advice (p=0.049) and 2) the association between maternal status in the household and providing ORS for treatment of diarrhea (p=0.111). All other relationships tested demonstrated weaker associations.

[141] The outcome variable of "Sought advice when child was ill" refers to whether a caregiver sought treatment advice in response to childhood fever, cough or diarrhea (among children 6 months to five years).
[142] Lack of diagnostic data on the type of cough or fever present did not permit similar bivariate analyses to be undertaken with outcome variables, such as having provided correct treatment in case of cough or fever.

Table 14.5 Relationship between Resources Available for Care and Child Health Practices

	Sought Treatment Advice when Child was Ill (%)	ORS Provided for Diarrhea (%)
a. Education Level of the Mother		
1. Literate	27.5	15.9
2. Not Literate	20.2	10.0
P value	P=0.049	P=0.137
b. Status of Mother		
1. Mother has decision making role in seeking health care for child	21.9	11.9
2. Mother does not have decision making role in seeking health care for child	17.9	6.3
P value	P=0.238	P=0.111
c. Number of Children in the Household		
1.One child under 5 years	19.7	10.0
2.Two or more children under 5 years	22.6	11.9
P value	P=0.244	P=0.484
d. Household Type		
1.Female headed household	21.6	12.9
2. Male headed household	21.1	10.8
P value	P=0.915	P=0.718

Key Findings and Program Implications

Seen together, the results from this Chapter highlight three essential facets to consider when designing future health and nutrition interventions. First, health and nutrition relevant messages should be targeted to a broad base of demographic groups. While the value of targeting health and nutrition messages to mothers should not be overlooked, expanding the target group could offer extraordinary impact. Our results show, for example, that children whose mothers lack a decision-making role in the household receive less appropriate care. It would therefore seem all the more important that the other influential members of the household also be targeted for behavior change and child health and nutrition education messages. These persons are likely to be siblings, grandmothers, or fathers of the child, as indicated by the data discussed earlier on primary and secondary caregivers.

Second, programmatic efforts to increase women's status in the household would likely further promote adoption of positive feeding practices. This is indicated both by our study of the relationship between women's role in decision making and infant and child feeding practices, as well as by the positive association shown between female headed households and adoption of recommended infant and child feeding practices. Providing women with access to micro credit projects and training for income generating activities are interventions that could help to

augment women's status and decision making ability in the household. Related to this is the impact that women's increased education and improved literacy skills would be expected to demonstrate over the long-term.

Third, efforts for increased birth spacing, both through women and men's improved knowledge and access to contraceptive services, could effectively promote the nutritional well-being of mothers, as well as her time availability and the care resources available for each of her children.

Chapter Fifteen. Neonatal and Maternal Health

During pregnancy, the health of the developing fetus is directly linked to the health and nutrition status of the mother. Women's dietary intake, for example, influences the availability of certain nutrients to the developing fetus. Women deficient in vitamins or minerals are unable to provide the required quantity of nutrients to the infant, resulting in negative outcomes for the growth and development of her child. Poor maternal health acts in a similar way to cause negative consequences for the infant. Any infection or disease that puts the health of the mother at risk also puts the health of the unborn infant at risk. In developing countries, maternal death during pregnancy or in childbirth usually means death for the infant also.

Several practices can contribute to reducing maternal, peri-natal, and neo-natal deaths, and poor pregnancy outcomes in developing countries. Interventions related to access and use of pre- and post-natal care, improvement of women's nutritional status, and promotion of optimal child spacing are all recognized as important to protecting maternal and infant health and nutrition. The extent to which these services are available and received in Ethiopia is discussed below. The findings are results from analyses among those households for which the mother of the reference child was the survey respondent. The data represent the practices undertaken during the pre- and post-natal period for the reference child.

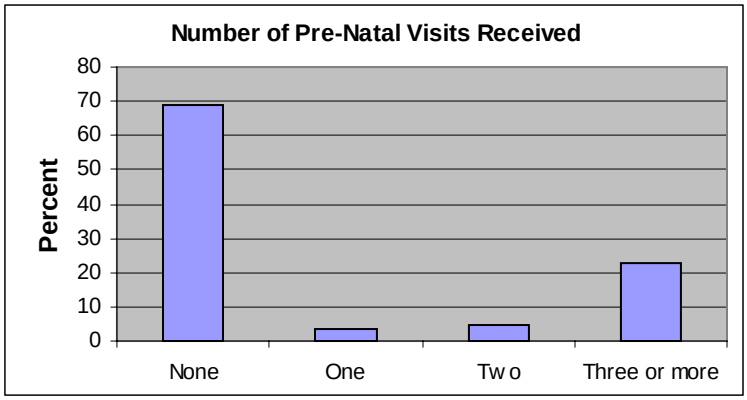
Pre-natal Care Practices

Quality pre-natal care offers important preventative health benefits to the mother and her infant. Pre-natal care provides health workers an opportunity to identify and treat illness, communicate health messages, and allows for early detection of potential pregnancy complications. In addition, interventions for protection against iron deficiency anemia and neonatal tetanus can be provided to women during pre-natal visits. Yet, as shown in table 15.1, only one in three pregnant women in the Title II Program area report having received prenatal care. It is recommended that this low rate of pre-natal use receive attention by Cooperating Sponsors.

Table 15.1 Summary Data on Maternal and Neonatal Health

Maternal Neo-natal Health Practice	Percent
Received pre-natal care[143]	32.3
Trained health worker at pre-natal care visit[144]	98.7
Received full tetanus toxoid vaccination	38.2
Received iron supplementation during pregnancy	17.7
Optimal birth interval[145]	38.2
Trained health worker at birth	19.8
Received post-natal visit[146]	7.2
Trained health worker at post natal visit[147]	94.3
Received post-partum vitamin A supplementation	16.0

Figure 15.1[148]



The low rate of pre-natal use among women in the Title II Program area could be caused, in part, by lack of access to pre-natal services. As shown in table 15.2, analysis of the relationship between distance to pre-natal care and use of pre-natal services is statistically significant at p=0.001. Women who had at least three pre-natal visits are located a mean distance of nearly thirty minutes closer to pre-natal care services than those women who did not receive pre-natal care. Efforts to increase access to pre-natal services might be one intervention strategy for Cooperating Sponsors to consider; complementary strategies, including dissemination of

[143] This tabulation does not account for if the pre-natal care was provided by a trained medical provider.
[144] The value cited is for those women who received pre-natal care.
[145] The standard operational definition of the term, "Birth Interval" is the amount of time between the birth date of one child and the birth date of the subsequent child born to the same mother (Espeut 2002). The Title II Baseline Survey collected information on the amount of time between the birth of the reference child and becoming pregnant with an earlier/later child. To accommodate the standard use of the term a nine-month gestation period has been added to each of the birth interval time periods stated by survey respondents.
[146] This tabulation does not account for if the post-natal care was provided by a trained medical provider.
[147] The value cited is for those women who received post-natal care.
[148] The data shown in figure 15.1 reflect the number of pre-natal visits that were received with a trained health provider. For the purpose of this report, we have defined a trained health provider to include any of the following personnel: doctor, health officer, nurse, auxiliary, community health agent, trained TBA, or other trained medical staff.

information about the importance of pre-natal care to pregnant women, and influential household members, would also be recommended.

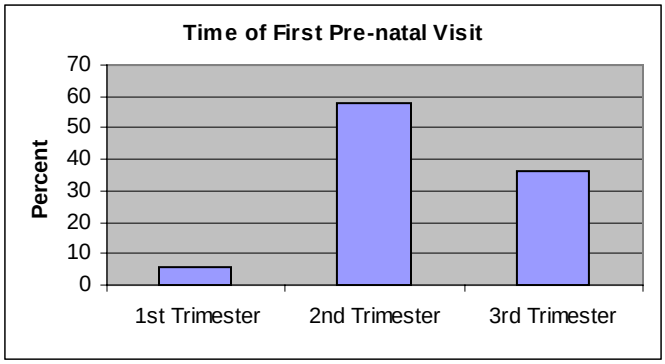
Table 15.2 Relationship between Receiving Pre-natal Care (3 or more visits with a trained medical personnel) and Distance to Pre-natal Care Services

Mean Distance to Closest Pre-natal Care Services (hours)	Number of Pre-natal Visits
117.6	Less than 3
91.6	3 or more
T value, P value	3.445, 0.001

Among those women having received pre-natal care, there are several positive practices which should be recognized. For example, 98.7% of women reported having a trained health worker/medical professional provide the pre-natal care, and, among those women receiving pre-natal care, the vast majority of women (73.4%) reported having received the recommended minimum of three pre-natal visits over the course of one pregnancy. Moreover, the majority of women receive their first pre-natal visit fairly early in pregnancy, either during the first (6.0%) or second trimester of pregnancy (57.7%).

While the high percent of women receiving early pre-natal care should be recognized as an achievement, the percent of women receiving their first pre-natal visit in the third trimester of pregnancy remains too high. More than 35 percent of women who had a pre-natal visit did not receive pre-natal care until the third trimester of pregnancy (figure 15.2). Receiving pre-natal care late in the pregnancy, while better than having not received any pre-natal care, does not allow for preventative maternal health practices, such as iron supplementation to be provided throughout pregnancy. Moreover, the lack of monitoring by a trained health provider puts both the health of the woman and the fetus at higher risk.

Figure 15.2[149]



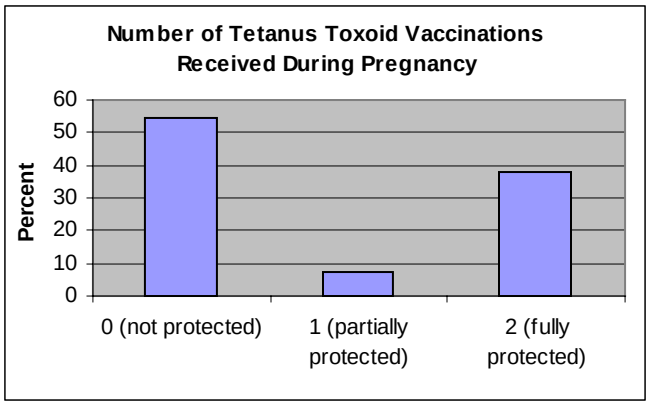
Pre-natal care received in the last trimester, particularly in the ninth month of pregnancy, is an important factor to consider when exploring the extent to which the health of the mother and unborn child are protected during pregnancy. Pre-natal care received late in the third trimester can facilitate a safe delivery by identifying potential delivery complications, such as infection, hypertension, and malpresentation, and taking into account the likely location and surrounding

[149] This tabulation does not account for if the pre-natal care was provided by a trained medical provider.

circumstances of the delivery. Of course, pre-natal care received in the last trimester of pregnancy should be in addition to earlier pre-natal care received. In Ethiopia, more than half of all women received pre-natal care at some time in the ninth month of pregnancy and more than twenty five percent of women received pre-natal care during the eighth month of pregnancy.

Adherence to the recommended two maternal tetanus toxoid vaccinations is practiced by about one in three pregnant women. As shown in figure 15.3, 38.2 percent of the reference births were fully protected against neonatal tetanus (2 or more tetanus toxoid vaccinations) and 7.6 percent of the reference births were partially protected (1 tetanus toxoid vaccination). More than half[150] of reference births were indicated as not protected against neonatal tetanus. This lack of immunization against tetanus has potentially serious consequences for the health of the mother and the child.

Figure 15.3



During pregnancy, women's iron requirements not only increase, but the associated negative outcomes of iron deficiency are particularly severe. Iron deficiency during pregnancy is associated with increased maternal and peri-natal mortality, premature delivery, and post-partum hemorrhaging. In addition, iron deficiency during pregnancy is associated with negative developmental outcomes for the infant, including low birth weight and potential long-term cognitive impairments (Viteri 1998). In order to provide some protection against iron deficiency during pregnancy, supplementation with iron folate tablets is recommended.

Data from the Ethiopia Title II Baseline survey indicate less than twenty percent of women received iron tablets during the reference pregnancy (table 15.1). The percent of women following a full-course iron supplementation regime is, however, probably even lower, as the data reported here do not account for possible lack of adherence to the recommended iron supplementation regime. Guidelines usually recommend daily[151] iron supplementation to

[150] This number may, in fact, be smaller than indicated, due to a proportion of women who may have already been immunized during an earlier pregnancy. The data in figure 15.2 indicate tetanus toxoid vaccinations received during the pregnancy of reference, but do not account for earlier tetanus toxoid vaccinations that may have been received by the mother. Because tetanus toxoid vaccinations are effective for up to ten years, women receiving earlier tetanus vaccination(s) would already have acquired some protection from neonatal tetanus. Moreover, women having received greater than five tetanus toxoid vaccinations during the reproductive years will have already obtained permanent and complete protection against neonatal tetanus.

[151] Among some populations in developing countries, weekly iron supplementation may be an option, if a high compliance rate is expected (Beaton 1999).

women throughout pregnancy. While the data do provide information on the percent of women receiving iron tablets at some time during pregnancy, no data on the amount of tablets received or ingested are available. As a result, the results reported here do not provide a full understanding of the extent to which the full recommended iron supplementation regime was actually provided by a health worker or adhered to by pregnant women. A conclusive statement can be made, however, about the low percent of pregnant women receiving even one course of iron tablet supplementation.

Given that pre-natal visits are commonly used as an opportunity to provide services, including the distribution of iron folate tablets to pregnant women and administration of tetanus toxoid vaccinations, a relationship between number of pre-natal visits and preventative maternal and neo-natal care would be expected. This hypothesis is borne out when tested by statistical analysis with Pearson's Chi Square (table 15.3). Women receiving three or more prenatal visits more often received iron supplementation than those who received 0, 1, or 2 pre-natal visits (p=0.000)[152]. In addition, women who received pre-natal care more often received full tetanus toxoid vaccination during pregnancy than women who did not receive pre-natal care during pregnancy. In this case, the percent of women fully protected against tetanus toxoid increases substantially for each additional pre-natal visit received. The relationship is statistically significant at p=0.000[153].

Table 15.3 Maternal Health Practices by Frequency of Pre-Natal Visits Received with a Trained Provider

	Received Iron Supplementation during Pregnancy (%)	Received 2 Tetanus Toxoid Vaccinations during Pregnancy (%)
a. Number of Pre-natal Visits		
1. No pre-natal visits	6.4	23.7
2. One pre-natal visit	36.8	45.2
3. Two pre-natal visits	32.2	69.0
4. Three + pre-natal visits	45.4	75.0

These data reinforce the preventative health benefits of multiple pre-natal visits. Not only do multiple pre-natal visits allow for the monitoring of the mother's health to be undertaken, but increased pre-natal visits are clearly associated with better preventative health practices during pregnancy. The difference in iron supplementation and tetanus toxoid vaccination is substantial for those women who received three or more pre-natal visits as opposed to no pre-natal visits (39.0 and 51.3 percentage point difference, respectively). Multiple pre-natal visits are thus a factor likely associated with improved maternal health and positive pregnancy outcome, and ultimately may also relate to improved child health status. This finding suggests the importance of Cooperating Sponsors continuing to encourage and promote the benefits of pre-natal care, and, in particular, the services that can be received with multiple pre-natal visits.

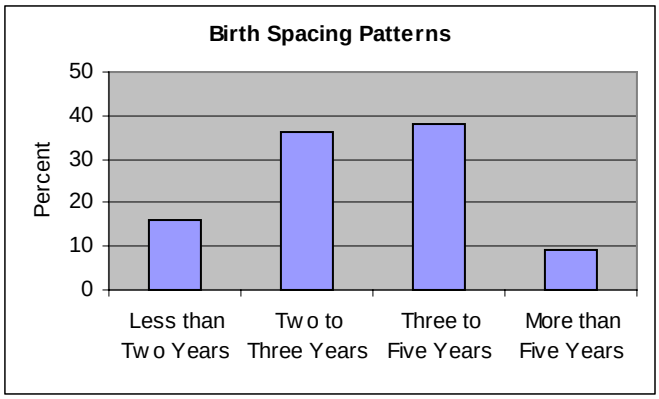
[152] The p value of 0.000 refers to the difference in the percent of women having received iron supplementation for 3 vs. 0 pre-natal visits having been received.
[153] The p value of 0.000 refers to the difference in the percent of women having received full protection against tetanus toxoid for 3 vs. 0 pre-natal visits having been received.

Birth Spacing

Birth spacing refers to the amount of time between the births of consecutive children. Appropriate birth spacing is an important factor for promoting good maternal and child health. Recent research suggests that children born three to five years after a previous birth have better health at birth and a reduced risk for mortality throughout infancy and childhood. In fact, children born three to five years after the previous child are shown to be about 2.5 times more likely to survive to age five than children born less than two years after the previous child (Setty-Venugopal 2002).

The Ethiopia baseline survey collected data on the birth interval practiced between the reference child and the child born just prior. The results show 38.2 percent of women in the Title II area to have practiced the recommended birth spacing interval of between three and five years (figure 15.4). 36.4 percent of women fall within the category of two to three years and only 16.1 percent have practiced spacing of less than two years. While these results are encouraging, efforts for increased spacing between births are still recommended. Given that 16.2 percent of women are practicing birth intervals of less than two years, increased spacing between births may have the potential for enhancing the health of newborns and threat of child survival. Such increased birth intervals might help also to relieve time and resource constraints related to caregiver capacity to provide adequate care to multiple children under five years, as indicated by the bivariate results shown in Chapter 14.

Figure 15.4



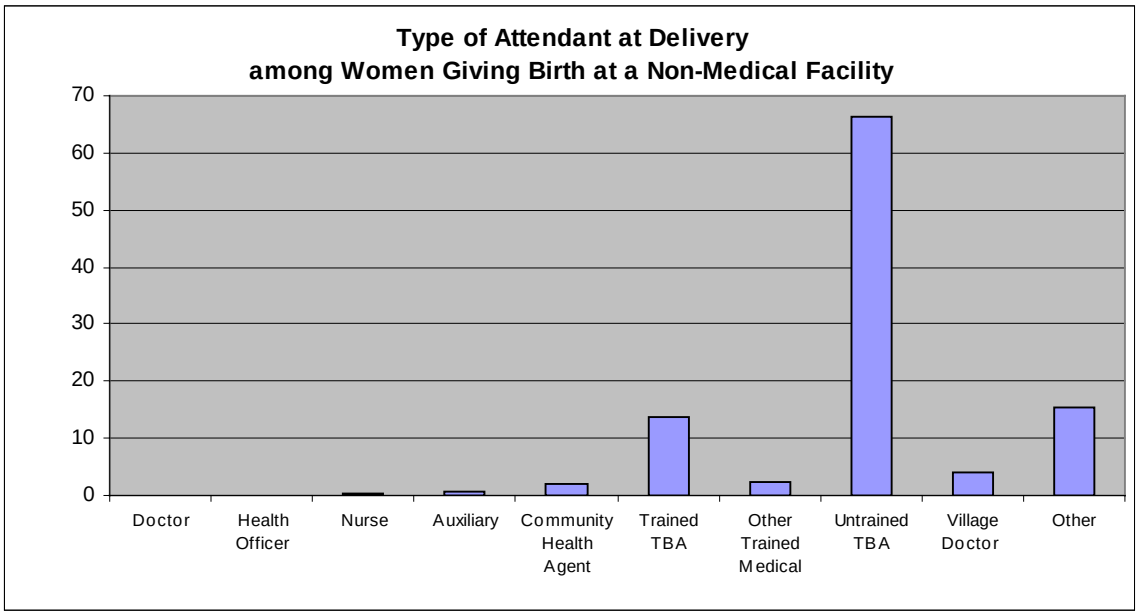
Because birth spacing is a practice requiring negotiation and planning between partners, women's ability to follow birth spacing recommendations is likely related to her level of influence in the household. While efforts for optimal birth spacing should include appropriately targeted messages about birth spacing, interventions addressing women's status and influence in the household are also recommended. Access to family planning services might be an additional constraint for households in certain communities and could be a complementary factor identified for attention by Cooperating Sponsors.

Health Care Received at Delivery

Almost all births in Ethiopia take place at the home of the mother (95.3%), or at an alternate home setting (3.0%). Although less than two percent of births take place at a health institution, this practice should not necessarily be of high concern for Cooperating Sponsors. More important than delivery location may be the presence of a trained attendant at the time of delivery.

Figure 15.5 presents the type of personnel present at the time of delivery, for those women who delivered at a non-medical setting. The results indicate that only 17 percent of those women who delivered at a non-medical setting reported having a trained medical provider present. Overwhelmingly, births at a non-medical facility are assisted by untrained traditional birth attendants. In addition, about 15 percent of births are assisted by a non specified untrained person, such as a relative, friend, or neighbor.

Figure 15.5



The presence of a trained health worker during delivery increases the likelihood that neonatal and post-partum infection will be prevented, and that referral to emergency health care will be made, when appropriate. Further, health messages are shared when a trained health worker is present at birth; the relationship between the health worker and the mother can be established, and important infant feeding and care guidance can be provided. In Ethiopia, roughly one in five women report having a trained health worker present at delivery (table 15.1). This presence of a trained health worker is related to the accessibility of delivery services (table 15.4).

Table 15.4 Relationship Between Trained Health Worker at Birth and Distance to Delivery Services

Mean Distance to Closest Delivery Services (hours)	Trained Health Worker at Delivery
84.0	Yes, trained health worker at birth
96.4	No, trained health worker not at birth
T value, P value	2.408, 0.016

Post-natal Care

The post-natal visit is an important opportunity to initiate follow up with the mother and her newborn. The visit allows the health worker to monitor the health of the mother and her infant, as well as to provide additional guidance to the mother on proper feeding and care of the child.

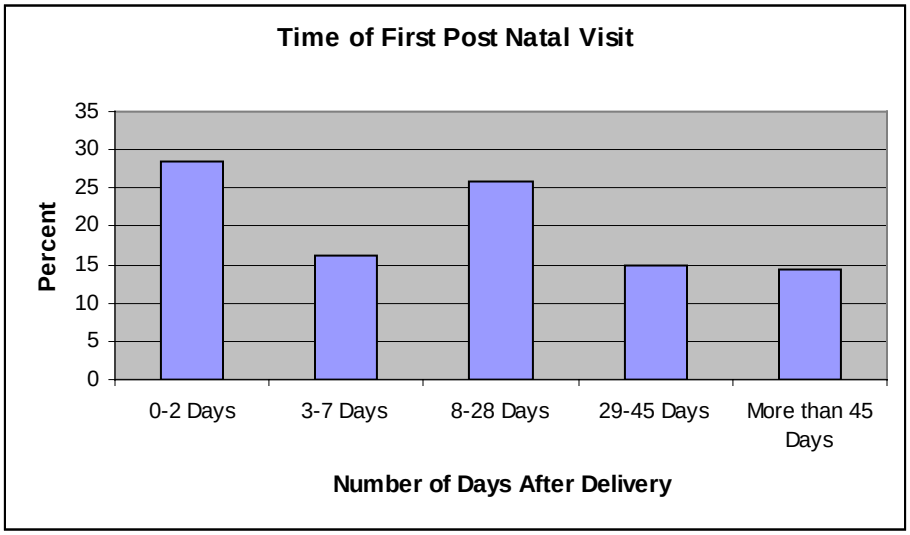
The Ethiopia Title II Joint PVO Baseline survey collected data on the timing and location of the post-natal visit, if there was a consultation with a trained health worker, and if micronutrient supplementation was received.

In general, the data indicate post-natal care to be an area of concern. Only 7.2 percent of women having a post-natal visit following the reference pregnancy (table 15.1). Among those women receiving post-natal care, the post-natal visit most often takes place at a health station/health post (48.1%). Post-natal care at the woman's home (26.0%) or at a hospital/health center (24.0%) is also common[154].

The timing of the post-natal visit is important for ensuring optimal protection of the health of the mother and her infant. Ideally, a post-natal visit with a trained health worker occurs within the first days following delivery. The period immediately after delivery represents a time of increased vulnerability for the health of the mother and infant. Post partum infection and hemorrhaging are most likely to occur at this time, and the first few days of life for an infant are critical. Among those women receiving post-natal care, the timing of the first post-natal visit was most often made within the first two days of delivery. Nearly all women receiving a post-natal visit met the recommendation to have received post-natal care within 45 days of delivery (figure 15.6). While these results may at first seem encouraging, it should be remembered that these data on the timing of the post-natal visit represent the practices only among the 7.2 percent of women who received post-natal care. Further, these results do not account for if the post-natal care was provided by a trained medical provider. With this in mind, it becomes clear that nearly all women in the Title II Program Area did not receive post-natal care with a trained medical provider, and thus, also did not meet the PVO target for receiving post-natal care within 45 days of delivery.

[154] These results do not account for if the post-natal care was provided by a trained medical provider.

Figure 15.6



The timing of the post-natal visit is also important for providing vitamin A supplementation to the mother. Supplementation of women post-partum is a critical intervention, both for increased maternal and infant vitamin A stores. Post-partum supplementation helps to restore the mother's vitamin A stores and enriches the vitamin A content of her breast milk. International guidelines recommend that in countries with vitamin A deficiency, all mothers should receive a dose of vitamin A (200,000 IU) within 6-8 weeks of giving birth. Vitamin A does, however, have potential teratogenic effects and should only be provided during the natural period of infertility that follows pregnancy. For breastfeeding mothers this period of natural infertility extends through the first eight weeks following delivery. For mothers not breastfeeding the "safe infertile period" is shorter, extending only through the first six weeks following delivery.

In the Title II Program area, only 16.0 percent of women reported receiving vitamin A supplementation sometime in the first two months following pregnancy. This low rate of vitamin A coverage likely has negative effects both on maternal and child nutritional status, especially given that all other available data would suggest vitamin A deficiency to be a problem in the Title II Program area**.** Distribution of post-partum vitamin A supplementation is often facilitated if provided immediately following delivery or during a post-natal visit. Results from the Title II data support this intuition: Roughly 30 percent of women with a trained health provider at delivery and 40 percent of women having received post natal-care with a trained health provider were provided vitamin A supplementation post-partum. In comparison, only 12.6 percent of women without a trained health provider present during delivery and 14.3 percent of women not receiving post natal care received the recommended vitamin A supplementation (table 15.5). Efforts to increase both the frequency with which trained health workers are present at time of delivery and with which post-natal care is received may therefore offer simultaneous improvement in post-partum vitamin A supplementation coverage rates.

Table 15.5 Relationship between utilization of health services with trained medical personnel and maternal vitamin A supplementation

	Received Vitamin A Supplementation (%)
	a. Safe Delivery
1. Trained health provider at birth	29.4
2. No trained health provider at birth	12.6
P value	P=0.000
	b. Post-Natal Care
1. Received post-natal care[155]	40.1
2. Did not receive post-natal care	14.3
P value	P=0.000

Bivariate Results: Resources Available for Care and Use of Health Services

Several of the maternal and neo-natal health practices discussed are hypothesized as related to outcomes of child health, an underlying factor affecting child nutritional status. The practices of: 1) receiving pre-natal care (three or more visits); 2) having a trained attendant present at time of delivery, and 3) adherence to the recommended child immunization schedule are predicted to show a strong association with child health outcomes. Because of the hypothesized relation with improved child health status, it is useful to explore the potential factors influencing the practice of these positive behaviors. Bivariate exploratory analyses on these outcomes have therefore been undertaken. The independent variables believed to have a likely role in determining each of the outcomes of interest are: 1) socio-economic status of the household; 2) maternal literacy, 3) number of pregnancies; and 4) household type.

As shown in figure 15.7, the socio-economic status of the household shows a significant relationship only with children's immunization status. The lack of relationship demonstrated with other outcomes of interest is not surprising, given our earlier findings on the relationship between household wealth and various infant and child feeding and health practices (Chapters 12-14). There are several different possibilities which might help to explain this general lack of effect we find household wealth to have on caregiver practices and utilization of health services in the Title II Program area in Ethiopia. These include: 1) the categories of household wealth do not represent meaningful differences between levels of wealth, that is, all households may, in essence, be "poor"[156]; 2) the bivariate relationship between household wealth and the outcome of interest does not provide an accurate portrayal of the association of the variables, due to confounding effects of unaccounted variables. This possibility will be explored more closely in Chapter 16 by multi-variate analyses techniques.; 3) as indicated in chapter 14, a lack of general resources (as opposed to solely financial resources) for providing care may be an especially

[155] Only those women who received post natal care with a trained medical provider are included in category 1 of this tabulation. Women who did not receive any post natal care and women who received post natal care with an untrained medical provider are included in category 2 of this tabulation.

[156] This hypothesis has been already discussed, as a potential explanation for the lack of relationship between household wealth and child nutritional status (refer to Chapter 12). A more detailed description of the hypothesis is included as part of that earlier discussion.

important determinant of the ability to adopt positive caregiver practices in the Title II Program area; 4) certain child health and nutrition outcomes may be more strongly related to the relative success/failure of the health care delivery system in the community than to the difference in the relative level of wealth across households. The inadequacy of health care service delivery in the region has been evidenced by the low rates of child and maternal immunization, vitamin A and iron supplementation coverage, and pre-natal/post-natal service use reported here.

Figure 15.7

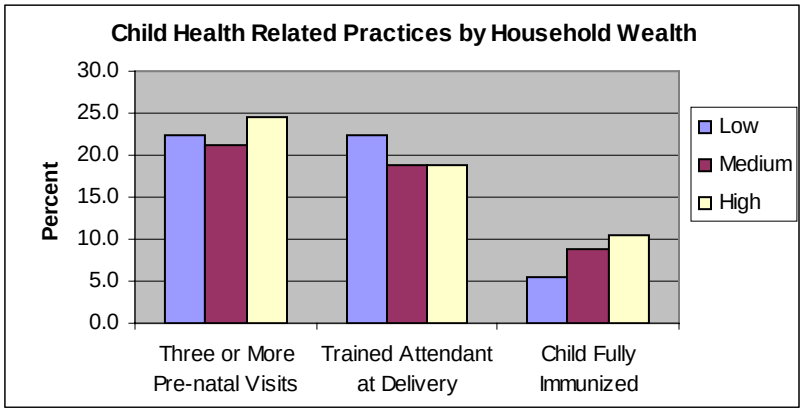


Table 15.6 shows results from the analysis of the relationship between resources available for care and health care service utilization. Several important associations are demonstrated; namely, in Title II Program area, higher maternal education is associated with a safe delivery (p=0.000), and both women who have had at least one child and women in female headed households are more likely to receive three or more pre-natal visits (p=0.006 and p=0.013, respectively). In addition, our results show children in male headed households to more often achieve full immunization status. We were surprised to see this association demonstrate statistical significance.

While no other statistically significant results are shown, similar trends are detected for the other associations tested. Maternal literacy and parity status are, for example, each indicated as a factor influencing use of recommended health services. These results provide preliminary evidence that resources available for care may not only play an important role in facilitating caregiver practices, but also in affecting utilization of health care services.

Table 15.6 Relationship Between Resources Available for Care and Maternal Use of Health Care Services

	Three or More Pre-natal Visits (%)	Trained Attendant at Delivery (%)	Child Fully Immunized (%)
a. Maternal Literacy			
1.Literate	24.2	27.6	6.1
2.Not Literate	22.0	18.8	8.7
P value	P=0.393	P=0.000	P=0.163
b. Number of Pregnancies			

	Three or More Pre-natal Visits (%)	Trained Attendant at Delivery (%)	Child Fully Immunized (%)
1. First pregnancy	17.2	18.6	9.4
2. Not first pregnancy	23.2	19.9	8.2
P value	P=0.006	P=0.527	P=0.464
c. Household Type			
1. Female headed household	29.4	22.6	4.3
2. Male headed household	21.5	19.6	8.8
P value	P=0.013	P=0.312	P=0.048

Key Findings and Program Implications

The findings presented in the Chapter reveal that the recommended maternal and neo-natal practices are not commonly followed in Ethiopia. Instead, the data have shown pregnant women in the Title II Program area to be at risk for an unsafe delivery or associated negative pregnancy outcome. To review our findings: only one in three women in the Title II program area receive pre-natal care; most women give birth without a trained provider in attendance; protective health services such as tetanus toxoid vaccination, iron supplementation during pregnancy, and vitamin A supplementation after delivery are rarely received; and only one in ten women in the Title II program area receive post-natal care. Moreover, women in their first pregnancy tend to be less likely to follow the recommended maternal and neo-natal practices than those women who have been pregnant before.

From these findings, several program implications can be identified. The importance of multiple pre natal visits, the need for a trained health provider at delivery and post-natal care needs to be emphasized. Cooperating Sponsors in Ethiopia should therefore continue to disseminate messages promoting the health benefits associated with these practices. Moreover, because our results suggest that women having already experienced pregnancy are more aware of the health benefits associated with preventative care/use of health services, Cooperating Sponsors might also consider how to better target women in their first pregnancy with health related information and messages.

In addition, mechanisms to facilitate women's adherence to recommended pre-and post-natal health practices are needed. Greater accessibility and outreach by the health system may be indicated. When designing relevant programmatic interventions, consideration should also be given to cultural norms surrounding the pregnancy and post-partum period. In certain regions of the Title II Program area, innovative approaches may be necessary to reach women during the pre-and post-partum period.

Lastly, because women's education level and access to and control over household resources appear to influence the use of health services both during and after pregnancy, interventions providing increased training and education to women would also be recommended. Direct interventions that enhance women's access to and control over resources would likely also demonstrate a positive effect on utilization of health care services, and ultimately on maternal and child health and nutrition status.

Chapter Sixteen. Multivariate Analysis of the Determinants of Infant and Child Nutrition and Health

Introduction

In this chapter, we conduct multivariate analyses on select child health and nutrition related outcome variables. Two health and nutrition outcomes are discussed: 1) Height for Age Z Score and 2) Diarrhea. The analytic methods undertaken include both linear (OLS) and logistic regression (LOGIT) analysis. Our results offer explanation for some of the bi-variate relationships not earlier understood, and confirm some of the findings already presented. Complex behaviors between variables on particular outcomes, such as the interactions between household characteristics and caregiver behavior on nutritional status, are also explored in this chapter.

Model 1: Height for Age Z Score

Method

Ordinary Least Square (OLS) Regression analysis was used to define the model to predict height for age Z score. The model was defined for children 6-24 months, as this is the age range when nutrition should be particularly protected. The UNICEF conceptual model for understanding child malnutrition (figure 11.1) guided our analysis. Earlier results from the uni- and bi-variate analyses conducted in Chapters 11 to 15 were also considered. Household level variables (e.g. wealth of the household; access to water and sanitation) and care related variables (e.g. resources available for care and care-giving behaviors, including infant and child feeding practices) were all studied.

The general criteria for inclusion in the model was that the coefficient of the independent variable be significant at $p<0.05$. Interactions (both dichotomous and continuous) were also examined. Interaction terms were included when significant, at $p<0.10$. When an interaction term tested significant in the model, the variables constituting the interaction term were also included in the model, regardless of the significance level. Special care was taken to control for potential confounding effects. Every model tested included variables to control for the age and gender of the child. In addition, a variable representing the square of the child's age (age of child * age of child) was created and introduced in the equation. This is usual practice in nutrition models, and is done to improve the linearity of the data.

Results

The regression model for children's height-for-age Z score suggests child malnutrition is best viewed as a multi-factorial outcome. The results are largely in line with the conceptual framework defined in figure 11.1. In table 16.1, the independent variables included in the model are listed, and the beta coefficient, t and p values are each specified. As shown in the table, independent variables relating to a wide spectrum of household and caregiver characteristics, and types of care-giving behaviors are significantly associated with children's nutritional status in Ethiopia.

Table 16.1 Linear Regression Model - Dependent: HAZ – Children 6-24 months

Independent Variable	Std. coeff.	T value (p value)
Age of Child (in months)	-0.154	-2.886 (0.004)
Age of Child Squared	0.003	1.615 (0.107)
Gender of Child (female)	0.052	0.636 (0.525)
Received Food Aid in Last 30 Days	0.354	4.134 (0.000)
HH SES	0.087	1.511 (0.131)
Maternal Literacy	0.174	1.509 (0.132)
Water Consumption in Rainy Season	0.004	3.700 (0.000)
Knowledge on Handwashing (2 or more methods)	0.280	1.948 (0.052)
Food Group Diversity	0.005	0.147 (0.883)
HH SES * Food Group Diversity	-0.053	-1.744 (0.082)
Constant	-0.550	-1.394 (0.164)

Height for Age Z Score for Children 6-24 Months - Adjusted R Square: 0.126, F: 14.362, p=0.000

Resources for Care Giving

According to our results, household beneficiary status is among the variables most strongly associated with children's nutritional status in the Title II area in Ethiopia. When controlling for all other factors in the model, having been a recipient of supplementary food aid remains highly significant (p=0.000), so that those households receiving food aid are indicated to have children with higher height for age Z scores. These results would suggest the importance of interventions such as supplementary food aid during a period of elevated nutritional risk. The findings imply that food aid afforded households in the Title II area care giving resources that they would not otherwise have been able to access, resources that may have ultimately made an important difference in the nutritional status of children.

Initially, we had expected a strong relationship between household wealth and children's nutritional status. Our multi-variate results show, however, only a weak relationship. Although the association is in the expected direction, such that increased wealth implies a higher height for age Z score, the relationship demonstrated by our model is not statistically significant at $p<0.05$. As we stated earlier, we hypothesize that this lack of strong association is related to the drought crisis of 2002-2003, and the dilution of meaningful differences in wealth that may have occurred as a result. Under more normal circumstances, we believe that household wealth would have demonstrated a strong association with children's nutritional status. We therefore maintain that interventions to increase household wealth would be an important area for CS attention.

Our multi-variate results indicate that maternal literacy may also offer children's nutritional status some positive advantage. Although the relationship is not demonstrated at a level of statistical significance, our results from earlier bi-variate analyses can provide some complementary information. In Chapter 14, for example, a strong association was shown between maternal literacy and key infant and child feeding practices. In addition, maternal literacy was shown as significantly related to seeking and utilizing health care services.

Interventions to influence the education of caregivers, and, in particular, of women caregivers, are thus also likely to offer positive benefits for children's nutritional status.

Water, Sanitation & Hygiene

Our results also show a strong relationship between water and sanitation resources and children's nutritional status. In particular, an important association between total consumption of water and children's height-for-age Z score is indicated. When controlling for all other factors in the model, children in households accessing a greater quantity source of water are shown to have a higher mean height-for-age Z score. It might be noted that this variable accounts for the average quantity of water accessed by the household during the rainy season for purposes of both drinking and washing. The variable does not account for if the type of water is a protected or unprotected water source. Interestingly, access to a protected water source was shown by both bi-variate and multi-variate analyses to not have a significant association with children's nutritional status. This finding is in not out of line with other research on the topic showing water quantity to be more important than type of water accessed (Esrey, 1991). The reported association is therefore a likely finding. In fact, given the persistent drought affecting Ethiopia during May-August 2003, we believe the relationship between access to water and children's nutritional status in the Title II Program area may have been especially magnified during the time of data collection. The finding has important programmatic implications. The results suggest a need for concerted efforts to increase access to water for households in the CS intervention areas. Such interventions could be coupled with education on related water, sanitation, and hygiene topics, including, but not limited to, knowledge about when to wash hands as well as appropriate techniques for hand washing.

Infant and Child Feeding Practices

In chapter twelve, the international guidelines for infant and child feeding practices were described, and the current feeding practices in Ethiopia were compared against the recommended standard. Several associations between feeding practices and children's nutritional status were uncovered but those remained to be confirmed by multivariate analysis. Four infant and child feeding practices were explored in our final model: 1) continued breastfeeding 2) feeding frequency 3) dietary diversity and 4) bottle use. Recall that bi-variate analyses showed that none of the infant and child feeding practices behaved as expected (see Chapter 12). Our multi-variate analyses did not reveal any new findings related to these main effects tested.

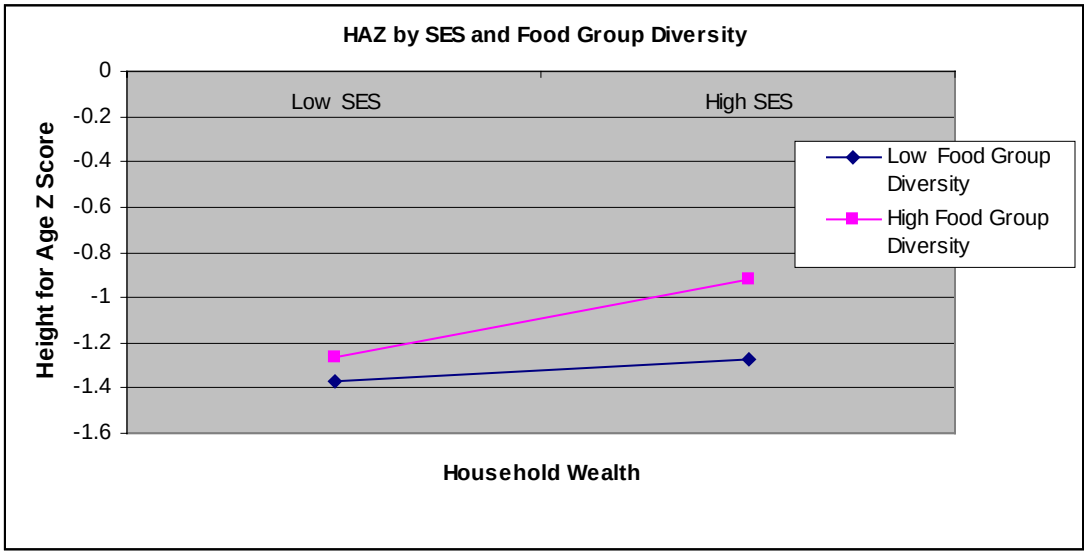
Interaction Terms

Interaction terms were created to test our earlier hypothesis that certain feeding practices might be best examined together in relation to nutritional outcome measures. None of these interaction terms were found to be significant at $p<0.10$ when included in the full regression model. Those results are therefore not included in Table 16.1.

Interaction terms were also created to explore the extent to which household wealth or maternal education might modify the effect that care giving practices, and water and sanitation resources may have on children's nutritional status. As shown in table 16.1, the interaction term for

'Household Wealth * Food Group Diversity ' is highly significant at p=0.082. This relationship, plotted in figure 16.1., shows children receiving a greater number of food groups in their diets to have higher height-for-age Z scores than children receiving less dietary diversity. Moreover, it shows that the benefits of dietary diversity are demonstrated most strongly among households with greater household wealth. Those effects are substantial. When adjusting for the other factors included in the model, children in higher wealth households who receive high dietary diversity have a mean HAZ of -0.92, whereas among lower wealth households, children receiving high dietary diversity have a mean HAZ score of -1.26. These findings reinforce the importance of our earlier recommendations for increased food group diversity in children's diets, as well as highlight the potential additive benefits that increased wealth could bring households in the Title II area.

Figure 16.1



Model 2: Diarrhea

Method

Binary Logistic Regression (LOGIT) analysis was used to analyze the determinants of child diarrhea. Household (e.g. wealth, water and sanitation resources of the household) and care-related variables (e.g. resources available for care and care-giving behaviors, including infant and child feeding practices) were studied as potentially associated with child diarrhea. Inclusion of variables in the LOGIT model generally followed the same criteria as was defined for the linear regression model[157]. Variables for the age and gender of the child, as well as a variable for the square of the child's age were included to address potential confounding and improve data linearity.

[157] Coefficient of independent variables were included at p<0.05 and interaction terms at p<0.10. Certain main effects were also included in the model when the significance was >0.05 but <0.10. When interaction term tested significant in the model, the variables constituting the interaction term were also included in the model, regardless of the significance level.

Results

Our initial analysis was guided by the assumption that the factors associated with child diarrhea would differ by age group: we expected to see practices such as bottle use and continued breastfeeding affect diarrhea prevalence among children of breastfeeding age (6-24 months); and to see household level sanitation variables such as water quality, water quantity and access to latrines affect diarrhea rates among older children (24-60 months). Those hypotheses are not supported by the empirical results; neither breastfeeding nor bottle use show up as important determinants of diarrhea among younger children. The results, however, suggest that for diarrhea, a model that considers all children jointly may be useful. The results from the revised model (children aged 6-60 months) is presented in Table 16.2.

Table 16.2 Logit Model - Dependent: Diarrhea – Children 6-60 months

Independent variable	Std. coeff.	Wald (p value)	Odds Ratio
Age of Child (in months)	0.001	0.005 (0.944)	1.001
Age of Child Squared	-0.001	3.944 (0.047)	0.999
Gender of Child (female)	-0.147	2.249 (0.134)	0.863
Female Headed Household	0.131	0.247 (0.620)	1.139
Mother Has Decision Making Role in Child Health	-0.243	3.373 (0.066)	0.785
Maternal Literacy[158]	-0.130	0.769 (0.381)	0.878
HH Wealth Index	-0.259	18.094 (0.000)	0.772
Knows 2 or More Times for Hand washing	-0.280	3.225 (0.073)	0.756
SES * Maternal Literacy	0.310	5.324 (0.021)	1.364
SES * Female Headed Household	0.846	9.552 (0.002)	2.331
Constant	-0.018	0.004 (0.947)	0.982

Diarrhea for Children 6-60 Months – Nagelkerke R Square: 0.068, p=0.000.

Resources for Care Giving

Previous results indicated that women caregivers with a higher status in the household have an increased ability to focus on child health and nutrition. Findings from Table 16.2 support this hypothesis: fewer children have diarrhea if they are from a household in which the mother has a decision making role in the health of that child. As those mothers are also more likely to provide recommended feeding practices to children and ORS for treatment of diarrhea (see Chapter 14), women with higher status also appear more likely to engage in preventative practices to protect their child from diarrhea, and to provide the correct treatment should diarrhea occur. Intervention to increase the status of women in the household are expected therefore to offer positive benefits for children's health status.

Another issue worth noting here is that CSs should not only engage in efforts for increase women's status, but also address the relative lack of adoption of appropriate health practices

[158] The variable for maternal education represents mothers having received four or more years of primary schooling versus mothers having received less than four years of primary schooling.

among households in which men hold the main decision making role. We recommend therefore that behavior change messages related to child health and nutrition also be designed for men. Such interventions would help to promote child health and nutrition among households in which women are not present, or may be prevented from acquiring an influential role in household decision making, and could facilitate men's support for women to pursue health related objectives with limited household resources.

Increased household wealth is also shown to be associated with child diarrhea ($p=0.000$). These results are preliminary, however. The exact nature of the relationship between household wealth and child diarrhea will be explored further in our discussion of the interaction terms included in the model.

Water, Sanitation & Hygiene

Water and sanitation conditions in the home are also expected to affect the prevalence of child diarrhea. Surprisingly, neither access to an adequate toilet nor access to a protected water source demonstrated significance in our basic model. Rather, the water and sanitation variable indicated as most important for protecting against child diarrhea is knowledge about hand washing. Those households in which caregivers could report two or more times when hands should be washed were less likely to have a child with diarrhea in the two weeks prior to data collection.

Interaction Terms

Two interaction terms are included in the diarrhea model shown in table 16.2: The first one explores how household wealth might modify the relationship between maternal literacy and child diarrhea; the second, how wealth might modify the relationship between household type (male vs. female headed) and child diarrhea. Both interactions are significant at $p<0.05$. Figure 16.2 first shows how maternal literacy is important in protecting children against diarrhea among low and middle SES households. A difference of nearly 10 percentage points in diarrhea prevalence is shown between households in the low wealth category where the mother is literate (20.0 percent) vs. those where the mother is not literate (28.8 percent). For households in the middle and higher wealth categories, the size of the differences are less, but still notable[159]. These results indicate that targeting education interventions will have important benefits for the health of the child, particularly among poorer households.

[159] The behavior of the data is somewhat perplexing, however: diarrhea prevalence among households where mothers are literate is lower for poorer households than for wealthier households. What we should expect is a horizontal trend. The same issue emerges with the second interaction. It is difficult to explain away this result. Again our main contention is that wealth categories are not good predictors of outcomes due to the stress that most households have suffered during the drought years.

Figure 16.2[160]

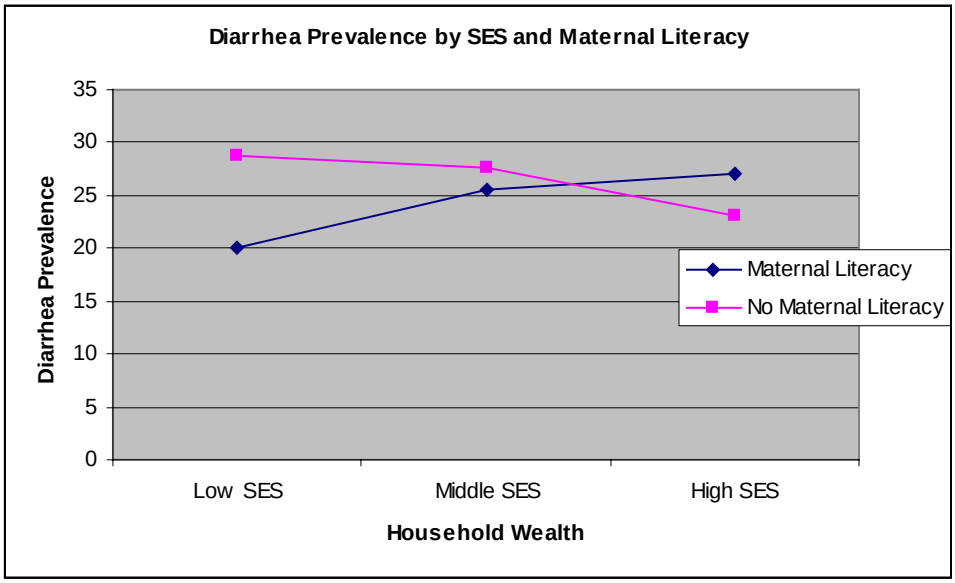
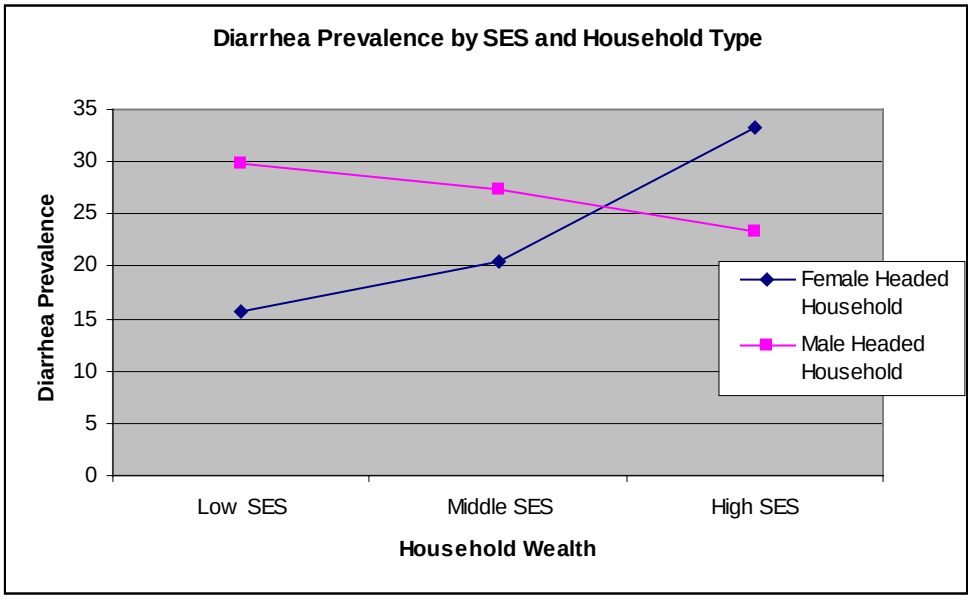


Figure 16.3 shows similar results. A difference in diarrhea prevalence of nearly 15 percentage points is shown between households in the low wealth category in which the household is headed by a female (15.6 percent) vs. those in which the household is headed by a male (29.8 percent). For households in the middle wealth category the size of the difference is about seven percentage points (20.5 percent in female headed households; 27.4 percent in male headed households). Among high SES households, factors such as maternal literacy or household type are not indicated as important for protecting against diarrhea, likely because households in the highest wealth category are more financially enabled to make decisions for protecting child health.

[160] The interaction shown in figure 16.2 is plotted for unadjusted means.

Figure16.3[161]



Conclusion

The results presented in this chapter represent key opportunities for health and nutrition programming in Ethiopia – intervention opportunities likely to demonstrate a positive impact on child nutrition over the long term. The findings are at once both more specific, and more definitive than those presented in earlier chapters of this section. Cooperating Sponsors might consider that many of the same type of caregiver and household factors are shown as significantly related to each outcome of interest. Most notable are those variables related to resources for care giving, especially those variables related to women's status in the household.

Maternal status in the household, as reflected by decision making ability, educational level, or control over household resources, appears to influence both the care sought and the quality of care provided to the child. This is in line with past development research on the subject, which has shown that women, in comparison to men, are more likely to spend their income on family welfare. In an effort to affect child health and nutrition outcomes in Ethiopia, it would therefore follow that well-targeted actions for improving women's access to credit and for providing skills-training for income-generating activities would be recommended. Of particular consideration might be facilitating women's opportunities for domestic based income generating activities so that the practice of an income generating opportunities does not entail necessarily a separation between a mother and her children.

An additional finding to note is how the caregiver's capacity to provide care to the child may affect outcomes of child health and nutritional status. From table 16.1 and table 16.2, it is evident that increased resources for providing care help to protect against negative child health and nutrition outcomes. Beneficiary status and household wealth each demonstrate relations

[161] The interaction shown in figure 16.3 is plotted for unadjusted means.

with the outcomes of interest tested. We continue to recommend that Cooperating Sponsors consider interventions to ameliorate household wealth, through providing appropriate training, micro credit, and income generating opportunities.

Among the infant and child feeding practices explored, dietary diversity was the only recommended practice which showed a relationship to prevention of child malnutrition. This effect was seen most clearly in households with greater wealth. As far as programmatic recommendations are concerned, Cooperating Sponsors might provide caregiver education on the importance of appropriate feeding practices such as breastfeeding, appropriate complementary feeding, no bottle use, and adequate dietary diversity. Given that our earlier analyses showed caregivers and decision makers to include fathers and grandmothers, such messages should be targeted to multiple demographic groups, not just mother caregivers. Complementary interventions would also seem critical. These would include efforts to increase caregiver access to diverse food types, both through increased household wealth or income generating opportunities, as well by providing information on promising home gardening or agricultural activities. Cooperating Sponsors could also consider providing educational sessions on simple meal preparation techniques for maintaining and/or enhancing the bio-availability of key food types.

The relationship between water and sanitation and child health and nutrition outcomes is also important to note. We see, for example, from tables 16.1 and 16.2, that variables related to water and sanitation resources and awareness about appropriate hygiene practices emerge as significant factors associated with both children's nutritional status and child diarrhea. The findings suggest that interventions for increasing access to water and for improving knowledge about hand washing would help reduce child malnutrition and child diarrhea.

In conclusion, the results from this chapter provide general guidance to CSs on key behaviors they should emphasize, and what interventions are most likely to improve child health and nutrition outcomes. As already described, Cooperating Sponsor activities addressing select care-giving practices (e.g. increased dietary diversity and hygiene practices), and maternal and household level characteristics (e.g. increased access to adequate water and sanitation facilities, and increased female status, possibly through maternal education and access to greater financial resources/household wealth) can offer substantial benefits, not only by reducing the prevalence of child diarrhea and stunting, but more generally, by improving the general health, nutrition, growth and development of children in Ethiopia. The results presented here should help them fine tune those interventions, both programmatically and in terms of who they target.

Chapter Seventeen. HIV/AIDS

Introduction

The HIV/AIDS pandemic imposes heavy consequences for household food security in developing countries. The impact of HIV/AIDS on food security can be seen at the individual, household, community, and national level. At the individual level, HIV/AIDS impedes the utilization component of food security[162], with deficits in appetite as well as in the absorption, transport, and utilization of energy, minerals, and nutrients occurring among HIV positive individuals. The impact of HIV/AIDS extends to the household, community, and national level by the increased vulnerability and reduced access to food which is imposed. The presence of HIV/AIDS causes a loss of productive labor, income, assets, and food reserves, all of which are recognized as important underlying elements for food security to be achieved (Bonnard, P 2002).

Food security programs can contribute to HIV/AIDS care and support, impact mitigation, and prevention efforts. In recognition of this, the Title II Cooperating Sponsors in Ethiopia took the opportunity to collect data on knowledge and practices related to HIV/AIDS, as part of the Title II Joint Baseline Survey. The results provide insight into common risk behaviors, prevailing misconceptions and gaps in knowledge related to HIV/AIDS. Ultimately, the data help to inform program planning, so that appropriate interventions for preventing and controlling HIV/AIDS can be developed by the Title II PVOs in Ethiopia.

Methods

The Title II Joint Baseline Survey represents the first effort by the Cooperating Sponsors in Ethiopia to collect data on attitudes, knowledge and practices related to HIV/AIDS. Five main topic areas were included in the Joint Baseline HIV/AIDS questionnaire: 1) sexual history, namely, number, types of partners and condom use; 2) knowledge about Sexually Transmitted Infections (STIs) and HIV/AIDs; 3) stigmatizing attitudes and discrimination related to HIV/AIDS; 4) mother to child transmission of HIV/AIDS; 5) HIV/AIDS support and care. The questions asked in the Title II JBS HIV/AIDS modules were taken from the FHI Behavioral Surveillance Survey (BSS) that had been administered to farmers and pastoralists in Ethiopia in 2002.

A separate sampling scheme was not used for carrying out the Title II JBS HIV/AIDS modules. Rather, the HIV/AIDS modules were administered at households visited as part of the Title II Baseline Survey. In each household, an effort was made to ask the HIV/AIDS questions with either the male head of household/male in charge of agricultural activities for the household or with the female head of household/biological mother/caregiver of reference child. Data were only collected from men and women between the ages of 15 and 49 years.

[162] In Chapter 2 we defined food security as: "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" (USAID, 1995). There, we explained the concept of food security as divided into three distinct dimensions: 1) food availability, 2) food access, and 3) food utilization.

The recommended HIV/AIDS survey protocol of same sex question administration was followed: male enumerators asked the HIV/AIDs module of male respondents and female enumerators asked the HIV/AIDs module of female respondents.

Limitations

Due to the demographics and organization of the enumerator teams, some constraints to data collection were realized. Each survey team had only one enumerator trained to administer the questionnaire to the respondent. As a result, only one HIV/AIDS questionnaire could be carried out at each household visited. Whether the HIV/AIDS questionnaire would be carried out with a male or female respondent at the household was dependent on the gender of the enumerator. Because the majority of enumerators for the Ethiopia JBS were male, many more male than female respondents were asked the HIV/AIDS modules. The uneven sample sizes diminish the extent to which the survey results can be considered representative. An elevated non-response/refusal rate for the HIV/AIDS questions further reduced the final sample size of HIV/AIDS related-data. Out of the 4649 total households visited, 827 HIV/AIDS surveys were completed with female respondents and 1634 HIV/AIDS surveys were completed with male respondents. Thus, although the results provided below can be seen as indicative of the larger trend, they cannot be viewed as representative of the total.

Context

Ethiopia is currently experience a generalized[163] HIV epidemic (FHI 2002). The HIV sero-prevalence rate among adults in Ethiopia is currently estimated at around 6.6 percent (FHI 2002). There is large variation indicated, however, across demographic groups. In a recent review of the available HIV sero-prevalence data, Kebede et al (2000) reported the prevalence of HIV as 6.4 percent among blood donors in Addis Ababa, 15 percent among women receiving antenatal care in Addis Ababa and 9.1 percent among visa applicants in 1999 (FHI 2002, MOH 2000, Tugbaru 1999). HIV sero-prevalence among high-risk groups such as commercial sex workers and truck drivers is presumed to be even higher. To date, few studies have collected sero prevalence data from adult men and women in rural areas. What little data are available indicate the HIV prevalence as around 3.7 percent for these population groups (FHI 2002, MOH 2002).

The primary mode of HIV transmission in Ethiopia is through heterosexual contact. As a result, sexually active adults are among the most frequently infected in Ethiopia, with current trends indicating an increasing proportion of young people becoming affected, likely due to unsafe sexual practices (FHI 2002). While farmers and pastoralists in rural areas are at relatively low risk for HIV infection (compared to female sex workers, uniformed services, youth and drivers), it is recognized that collecting data on their attitudes, knowledge, and practices related to HIVS is essential to a comprehensive approach for addressing the HIV/AIDS pandemic in Ethiopia. The results presented here can be used to help prioritize and inform prevention and education messages to rural men and women in the Title II program area.

[163] A generalized HIV epidemic is defined as an epidemic where the HIV sero-prevalence level among sexually active adults in the general population is above one percent (FHI 2002).

Results

Sexual History

According to the responses to our questions on the sexual history, sex with high risk partners[164] is infrequent in the Title II Program area. Few respondents (1.5% men, 0% women) report having had sex with commercial sex workers or non-regular partners over the last 12 months. Sex with a non regular partner or some other partner was reported slightly more frequently, with 2.5 percent of men and women reporting having sex with either a non regular partner or some "other partner" in the last 12 months. The one notable difference between men and women's sexual history relates to the "regular" partner (presumably the spouse). More men than women reported having a sexual encounter with a regular partner in the last 12 months.

The data show condom use as infrequent both among men and women with their high risk partners. Roughly one in three men reported condom use with a commercial sex partner or with an "other" type of partner, and only about 14-15 percent of men and women reported condom use with a non-regular partner. These data should be interpreted with some caution, however, given that the sample sizes for condom use with commercial, non regular, and other partners are very reduced for both men and women.

Table 17.1. Sexual history of respondent

	Male	**Female**
Mean age of respondents to HIV/AIDS questions	34.6 years (n=1634)	31.4 years (n=827)
Sexual partners in the last 12 months		
Regular partner[165] (1 or more reported)	91.3% (n=1595)	81.5% (n=729)
Commercial partner[166] (1 or more reported)	1.5% (n=1396)	0% (n=652)
Non regular[167] (1 or more reported)	2.0% (n=1398)	2% (n=651)
Other[168] (1 or more reported)	0.5% (n=1392)	0.5% (n=645)
Condom use during last sex with partner		
Regular	2.1% (n=1377)	1.5% (n=583)
Commercial	36.8% (n=19)	Not Applicable
Non Regular	14.3% (n=28)	15.4% (n=13)
Other	33.3% (n=6)	0% (n=3)

[164] For the purpose of this report, "high risk partners" are defined as sex with a commercial sex worker or non regular partner. For the operational definitions of the different types of sex partners asked out in the Title II JBS, refer to table 17.1.
[165] A regular partner is defined as a spouse or live in sexual partner.
[166] A commercial partner is defined as a partner who is paid for sex.
[167] A non-regular partner is defined as a sexual partner who is not a spouse or live in sexual partner and who was not paid for sex.
[168] An other partner is defined as a sexual partner who is not a spouse or live in sexual partner, but with whom there has been a relation for more than 12 months.

Knowledge of Sexually Transmitted Infections (STIs)

Our results show men and women in the Title II program area to have different levels of knowledge about STIs. While 91.4 percent of men have heard of STIs, only 73.9 percent of women are aware that STIs exist. Respondents who had heard of STIs were asked to report symptoms they know as associated with STIs. All symptoms mentioned by the respondents were recorded. The results are shown below.

Compared with women, men were better able to name the most common symptoms of STIs in both men and women. Nearly fifty percent (47.3%) of men were able to name two or more[169] symptoms of STIs in women, whereas only 40.3 percent of women could, and more than 60 percent of men were able to name two or more symptoms of STIs in men, whereas only one in four women could.

While exact prevalence rates on STIs aren't available, some indicative data on the frequency of STIs were able to be obtained by respondent recall. STIs were reported to have experienced by around 5% of the men and women in the last 12 months. No information is available on the symptoms or type of STI experienced.

Table 17.2 Knowledge of STIs	**Male**	**Female**
Heard of STIs	91.4% (n=1561)	73.9% (n=747)
Respondent Knowledge of STI Symptoms in Women		
Abdominal pain	29.4% (n=1353)	15.8% (n=546)
Genital discharge	23.8% (n=1353)	17.6% (n=546)
Foul smelling discharge	18.6% (n=1353)	13.7% (n=546)
Burning pain on urination	40.6% (n=1353)	36.4% (n=546)
Genital ulcers/sores	14.7% (n=1353)	18.3% (n=546)
Swellings in groin area	14.6% (n=1353)	13.9% (n=546)
Itching	8.6% (n=1353)	17.4% (n=546)
Others	23.7% (n=1353)	24.0% (n=546)
Nothing mentioned	14.2% (n=1353)	17.9% (n=546)
Respondent Knowledge STI Symptoms in Men		
Genital discharge	40.2% (n=1412)	12.1% (n=547)
Burning pain on urination	69.1% (n=1412)	32.5% (n=547)
Genital ulcers/sores	37.2% (n=1412)	21.9% (n=547)
Swellings in groin area	41.5% (n=1412)	20.5% (n=547)
Others	15.2% (n=1412)	17.2% (n=547)
Nothing mentioned	5.9% (n=1412)	31.6% (n=547)
STI Experienced in the Past 12 Months		
Yes	5.4% (n=1578)	4.5% (n=730)
No	94.3%(n=1578)	94.2% (n=730)
Don't know	0.3% (n=1578)	1.2% (n=730)

[169] STI symptoms recorded as "other" are not included in the tabulation of the indicators, "knows two or more symptoms of a male/female STI," given that it is not possible to know if the "other" response represented correct knowledge of STI symptoms.

Amongst the surveyed respondents, there is a moderate level of awareness about HIV preventive methods[170]. Around 39 percent of men and 44 percent of women are aware of the three major HIV preventive methods. Nearly three out of four respondents are aware that abstinence from sexual intercourse can protect against HIV and more than fifty percent of men and women know that people can protect themselves from the HIV virus by using a condom correctly every time they have sex. Knowledge about preventing HIV by "having only one uninfected faithful sex partner" is shown to vary by gender of respondent. Whereas 80.3 percent of women replied that having only one uninfected faithful sex partner could protect against HIV, only 39.0 percent of men recognized this as a preventive method against HIV.

In order to assess the frequency of misconceptions about HIV in the Title II area, three false statements about HIV were read to respondents. These are shown below in table 17.3. The results indicate a high percent of men and women have misconceptions about possible transmission routes of HIV. Most men and women believe HIV can be acquired through mosquito bites and many think that transmission can occur by sharing a meal with an HIV positive person. Moreover, 61.2 percent of women and 47.8 percent of men do not believe that a healthy looking person could be infected with HIV.

Table 17.3 Knowledge about HIV/AIDS

	Male	**Female**
Known Protection Methods Against HIV		
Condom use every time have sex Yes Yes, but not 100% safe	 37.4% (n=1287) 13.7% (n=1287)	 57.1% (n=515) 4.3% (n=515)
Having only one uninfected faithful sex partner	39.0% (n=1486)	80.3% (n=654)
Abstinence from sexual intercourse	78.5% (n=1592)	73.9% (n=666)
Misconceptions about HIV		
Transmission possible by mosquito bites	65.6% (n=1266)	74.1% (n=541)
Transmission possible by sharing a meal with infected person	39.0% (n=1486)	54.3% (n=685)
A health looking person cannot be infected with HIV	47.8% (n=1391)	61.2% (n=657)

Stigma and Discrimination

To assess stigma and discrimination related to HIV/AIDs, seven indicators were used. These are shown in table 17.4 below. More than 90 percent of respondents are indicated to have at least one stigmatizing attitude about HIV/AIDs (men 94.6%; women 88.8%). Among the most frequent stigmatizing attitudes are: an unwillingness to share a meal with an HIV positive

[170] Each of the three preventive methods in table 17.3 were read as a separate question to the respondent. For each question, the respondent was asked if the method could protect against HIV.

person, a belief that PLWHA should be quarantined[171], an unwillingness to buy food from a shop keeper known to have HIV or to allow PLWHA to participate in community meetings and activities.

Table 17.4: Stigma and Discrimination		
	Male	**Female**
Willingness to share meal with HIV positive person (No)	71.7% (1571)	84.5% (744)
Willingness to buy food from an HIV positive shopkeeper/food seller (No)	71.8% (1590)	83.4% (745)
If a member of family became ill with HIV, would respondent want it to remain a secret (Yes)	36.1% (1583)	54.4% (732)
Willingness to care for male relative infected with HIV (No)	37.5% (1584)	37.0% (752)
Willingness to care for female relative infected with HIV (No)	37.0% (1585)	36.5% (748)
Willingness to allow a farmer infected with HIV to continue attending community meetings and activities (No)	53.3% (1562)	76.0% (713)
PLWLA should be quarantined (Yes)	62.1% (1611)	72.9% (757)

Mother to Child Transmission of HIV/AIDS

Among the men and women surveyed, almost all respondents are aware that mother to child transmission of HIV is possible. Most men and women know that a pregnant woman infected with HIV or AIDs can transmit the virus to her unborn child. In addition, the majority of men and women recognize breastfeeding is a possible mode of transmission.

Fewer respondents, however, have knowledge about how to reduce mother to child transmission of HIV/AIDS. While ten percent of men (13.0%) and women (10.5%) know that antiretroviral medication can be used to reduce the risk of transmission, one if four respondents do not think that it is possible to reduce the risk for mother to child transmission of HIV during pregnancy.

Table 17.5 Knowledge of mother to child transmission of HIV/AIDS		
	Male	**Female**
Recognized Modes of Mother to Child HIV transmission		
HIV/AIDS infected pregnant woman to her unborn child	92.9% (n=1368)	95.4% (n=693)
HIV/AIDS infected woman can to her newborn child through breastfeeding	89.3% (n=1387)	96.0% (n=700)
How to reduce risk of pregnant women transmitting HIV to her unborn child		
Take medication (Antiretrovirals)	13.5% (n=1582)	10.5% (n=760)

[171] While 72.9% of women replied "yes, people with HIV/AIDS should be quarantined, 25.8% did not think so, and 1.3% had no opinion. For men, the results for each of these responses are shown as 62.1%, 36.4%, and 1.5%, respectively.

Abortion	2.8% (n=1582)	3.7% (n=760)
Seek medical advice	25.7% (n=1582)	20.7% (n=760)
Nothing	22.0% (n=1582)	24.9% (n=760)
Other	2.2% (n=1582)	1.8% (n=760)

Support and Care

Respondents were also asked their opinions on practices for the support and care of persons living with HIV/AIDs. When asked how the body fluids of a sick or HIV/AIDS infected family member should be treated, about half of all respondents reported that they would was their hands after providing care for the family member, and thirty percent of men and 11 percent of women reported that they would use plastic gloves. Only a small percent of respondents reported that they would either ask someone else to help provide care or would take "other" measures for caring for the family member. Notably, one in five respondents (19.0% women; 20.2% men) reported that no special care would be taken when treating the body fluids of an infected family member.

Table 17.6 How to handle body fluids (diarrhea, vomit, sputum, blood) of a family member who has been sick for a long time or is an AIDS patient?
(% respondents mentioning each answer)

	Male (n=1596)	**Female** (n=762)
Wash hands after care	44.4%	50.0%
Use plastic gloves	32.0%	11.3%
Ask someone else to help	16.3%	7.6%
Other response	12.0%	10.6%
No special care needed	20.2%	19.0%

Home based care for AIDS patients is available in the communities of about 15 percent of the respondents. When asked an opinion on who should provide home based care services to AIDs patients, the most common responses were: health workers, family members, and religious groups. Volunteers and neighbors were mentioned less frequently and only a small percent of respondents reported some 'other' person should provide care.

Table 17.7 Who are the right groups for providing home based care for AIDS patients in your community (% respondents mentioning each answer)

	Male	**Female**
Family members	48.4% (n=1609)	46.0% (n=763)
Volunteers	31.4% (n=1609)	6.9% (n=763)
Neighbors	27.6% (n=1609)	3.9% (n=763)
Religious groups	44.6% (n=1609)	22.0% (n=763)
Health workers	74.0% (n=1609)	57.7% (n=763)
Others	11.2% (n=1609)	2.6% (n=763)

Key Findings and Recommendations

The effort by the Title II Cooperating Sponsors in Ethiopia to collect HIV/AIDS data should be recognized as an achievement. Not only did the survey contribute to the opening dialogue on HIV/AIDS in Ethiopia, but the findings provide baseline values around which appropriate interventions can be planned and from which program progress can be measured. Our results have shown that while most men and women in the Title II program have a general awareness about STIs and HIV/AIDS, comprehensive knowledge about HIV preventative methods and modes of HIV transmission is far less common. The findings therefore indicate that there is a large scope for information dissemination and behavior change in this area.

We recommend that Title II programs target increased knowledge about HIV/AIDS prevention methods and transmission modes. Educational campaigns to reduce stigmatizing attitudes and discrimination against HIV/AIDS are also strongly recommended. In addition, Cooperating Sponsors might consider strategies to improve access to voluntary counseling and testing in the Title II area. Our results indicated a high level of willingness to undergo voluntary counseling and testing (87.7% males, 84.1% females), yet few of these services are likely yet available in the Title II area.

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Annex 1: Types of Evaluations

Adequacy designs only describe whether a change has occurred or not in the intervention area. Typically, adequacy studies answer questions such as: Did the project reach its target? Or: Has the expected change happened? This type of evaluation is done by measuring the difference in outcome levels between the beginning and the end of the project; and comparing the size of that difference to expected size of impact. The evaluation consists basically in testing the hypothesis that this difference is equal or greater than expected. This design is the simplest of evaluative models, as it does not try to control for external effects. Data is needed only on outcomes and there is no need for controls other than historical ones (see below). The main drawback of this design is that it is not possible, due to lack of external controls, to infer that any change in intervention areas is indeed due to the program. Other processes (e.g. secular trends, changes in personal situations, national economic growth) could have caused the change even in the absence of the intervention. Conversely, where no change is recorded, it is not possible (again due to absence of controls) to say whether the lack of change is due to program inefficiency; or if the program has in fact impeded a further deterioration. In summary then, this type of evaluation cannot be used to causally associate the program with the changes observed. It may offer the assurance that certain objectives were reached, and that the program deserves continued support but if no change is observed, additional research will be needed to identify why this is so, and to guide further action.

Plausibility designs go beyond adequacy studies in their attempt to eliminate the influence of external (confounding) factors on observed effects. This requires that i) we define those confounding factors (and for this we need to specify a conceptual model of causes and effects); ii) that we measure those confounding factors in both cases and controls before the start of the intervention[172]; and iii) that we remove those effects through statistical treatment at analysis stage (either via matching, standardization or multivariate analysis); The plausibility analysis is done by measuring the difference in outcomes between the beginning and the end of the project at the level of "cases" (those that were exposed to the intervention); as well as at the level of "controls" (individuals, localities or organizations that share all characteristics with the cases except for their exposure to the intervention). Comparisons can also be made between cases and controls to explain differences in outcomes (or lack thereof) as a function of the amount of benefits received by the program, or the changes that have occurred at the level of covariates and/or confounding factors. Because of the great variety of situations being compared, differences in the quality of controls, and so on, the solidity of a plausibility statement can go from weak to strong. At the weakest level, a simple comparison across functional groups is made

[172] Controls can be of various types. *Historical* control implies the collection of outcome data among the same targeted institutions, regions or individuals before and after the intervention and an attempt to eliminate the role of external factors on that outcome by collecting data on confounding factors. *Internal* controls refer to institutions, regions or individuals that could have received the intervention but did not, either because they could not, would not, or because they received it at a different moment (note that the latter could allow for "dose/response" type of studies). *External* controls, finally, are like internal ones, with the exception that they were never targeted by the intervention. All types of controls require that the groups being compared be similar in all respect except their exposure to the intervention. One has to recognize that this is almost never possible, however, since there is always one factor that influences one group more than another. For instance, mortality due to diarrhea may be due to better access to drinking water, not to the ORS program. This is why the collection of information on confounding factors is critical.

to reduce counfounding factors (e.g. two-by-two tables). At the strongest level, mathematical simulations are used in doing the comparisons (e.g. multivariate regressions). The highest level of plausibility is reached when all alternate explanations have been considered and rejected. The stronger the assertion, the greater the data needs, and also the greater the analytical resources needed.

Evaluations based on probability designs, finally, are done to ensure that there is only a small and measurable probability that the difference between beneficiaries and controls is due to confounders, biases or to randomness. This is the gold standard of scientific research. Because it requires randomization in the assignment of participants (both in treatment and control groups[173]), it is in fact rare to find those types of design deployed in the context of implementation programs[174]. We do not dwell at length on this design, as it is more appropriate for clinical trials aiming at demonstrating precise causal relations than for project impact assessment. As this brief exposition of evaluation designs shows, the choice of design is dictated by a number of concerns including:

- The known effectiveness of the intervention (for instance, an immunization program does not need to demonstrate again cause-effect relationships; a measure of coverage is sufficient to represent the effectiveness of the program. Then an adequacy evaluation is sufficient).
- The audience being targeted: if the evaluation is to fulfill a donor's needs, then a measure of outcome before and after the intervention may be enough—thus the adequacy design would then be appropriate. If the audience is program designers, by contrast, then a measure of cause-effects relationships may be required so they can understand how to tailor their program to the local reality, in which case a plausibility design is called for.
- Cost: the three designs are ranked in order of scientific rigor. As a corollary, complexity and cost increase as one moves from one to the other. The final design selection must take into account financial limitations
- Time: analyses are sometimes required urgently, and cannot afford the delays associated with in-depth analysis of results. Or else, the findings will be of no practical use if it takes too long to provide them. In such a situation, the simpler evaluation design will be preferred.
- Capacity to produce the analyses: the more complex the design the more involved are the analyses. The in-house capacity to effectively carry out those analyses is a critical determinant of what type of design is to be selected.

[173] Randomization does not ensure the elimination of confounders, but it ensures that the probability of those factors still playing a role is known and small.

[174] Probability designs increase the level of difficulty by several notches. First, the evaluator must be present from the start to do the randomization. Second, in order to do a random assignment of cases, all social, ethical or political considerations must be set aside when selecting participants or sites, which may not be an option in an operational program. Third, the high scientific demands of those studies can create situations that are marginally related to field realities (high internal but low external validity). And last, probability studies are costly, and the tradeoffs between external and internal validity can make those useless to decisionmakers. For all those reasons, it is very rare to see a probability design in the context of a field program.

Annex 2. Explanation of the Econometric Models and Tests Used

One of the main concerns in estimating econometric models is to ensure that the explanatory variables are not correlated with the error term (u_{hp}). If there is such correlation, the resulting coefficients will be biased. For example, if land quality or weather vary across households and plots, these variations are not adequately reflected in the observed explanatory variables, and are correlated with observed explanatory variables like use of fertilizer, then the estimated effect of fertilizer on yield will tend to "pick up" the effect of these unobserved factors. If fertilizer use tends to be greater on higher quality plots or where the weather is better, and both of those contribute directly to increased yield, then the estimated impact of fertilizer will tend to overestimate the true effect of fertilizer on yield, since fertilizer is acting as proxy indicator of good weather or better land quality. This is especially likely to be a problem for variables that are chosen by the farmer in the current year, such as input use and land management practices, since the farmer usually chooses such inputs and practices having more information about the weather and land quality than we are able to collect or account for in our analysis.

We use three approaches to address this problem. First, we include as many observed variables as available to control for land quality and agro-climatic differences, such as soil type, slope of the plot, and altitude zone. Second, we also include dummy variables for each woreda in the sample, which reflect differences across woredas resulting from differences in weather, average land quality, access to markets and information, or other factors. Our estimates thus reflect within-woreda differences in yields and the factors affecting them, after controlling for all sources of average yield variation across woredas. Both of these approaches help to address the so-called "omitted variable bias" problem.

Our third approach is to estimate the model using instrumental variables estimation (also known as two-stage least squares estimation). The idea of IV estimation is to find variables that are not correlated with u_{hp} that are good predictors of endogenous explanatory variables that may be correlated with u_{hp} (such variables are called instrumental variables), use those variables to predict the endogenous explanatory variables using ordinary least squares regression, and then regress the predicted endogenous variables on y_{hp} using OLS.[175] Since the variables used to predict the endogenous variables are not correlated with u_{hp}, the predicted values of these variables are uncorrelated with u_{hp}, thus eliminating the so-called "endogeneity bias".

For IV estimation to be feasible, some of the instrumental variables used to predict the endogenous explanatory variables must be excluded from the regression (Davidson and MacKinnon 2004). At least as many instruments must be excluded as the number of endogenous explanatory variables in order for estimation to be possible (since otherwise there will be perfect multicollinearity between the predicted endogenous explanatory variables and the other explanatory variables), and additional exclusion restrictions ("overidentifying restrictions") further reduce the problem of multicollinearity and thus increase the statistical power of the model. To identify instrumental variables to exclude from the IV model, we used joint statistical significance tests of the full OLS model, excluding household level variables and land tenure

[175] Such a two-stage approach to estimate two-stage least squares is not much used any more, since this produces incorrect estimates of the covariance matrix of the coefficients (Davidson and MacKinnon 2004, p. 324). Modern econometrics software packages that include IV estimators use the appropriate estimator of the covariance matrix.

variables that were jointly statistically insignificant. Theoretically, such variables should not belong in a production function estimation if all inputs and land management practices were adequately measured and accounted for, since they are expected to affect production via their impact on choice of input use. But statistical testing enables us to have greater confidence that excluded variables do not affect yields directly and can be excluded. We also use as additional instrumental variables several variables indicating whether farmers have knowledge of different types of land management practices. Such knowledge should affect production only by affecting farmers' use of land management practices, and not directly after controlling for such practices, so should be valid to exclude from the regression.

We test the validity of the overidentifying restrictions using Hansen's J test (Ibid., pp. 367-368), which tests the joint hypothesis that the instrumental variables are uncorrelated with u_{hp} and can validly be excluded from the regression. Passing this test (i.e., if the test statistic is statistically insignificant) indicates that the IV regression model is valid. It is also important to test that the instrumental variables are good predictors of the predicted endogenous explanatory variables, because the results of IV estimation can be more biased (in a finite sample) than OLS if weak instrumental variables are used (Bound, et al. 1995). We thus test the joint statistical significance of the instrumental variables that are excluded from the regression in predicting the endogenous explanatory variables (called a "relevance test" of the instruments). Strong statistical significance indicates that the instrumental variables are relevant, helping to address the concern about weak instruments.

Even if the instrumental variables used in IV estimation are valid and relevant, IV estimation is less efficient that OLS, if the OLS model is consistent. However, the OLS model may be inconsistent for the reasons cited above (see Davidson and MacKinnon (2004) or another advanced econometrics textbook for definitions of efficiency and consistency of estimators). We use a Hausman (1978) specification test, to compare the two models. The Hausman test is designed to compare two estimators, one of which is consistent and efficient under the null hypotheses (OLS in our case, under the null hypothesis of no endogeneity bias), and one of which is consistent but inefficient under both the null and the alternative hypothesis (IV in our case). Rejection of the null hypothesis favors the IV model, while failure to reject supports the OLS model as the more efficient model.

The reduced form model investigates the impacts of only exogenous factors on crop yield. The effects of endogenous factors such as input use and land management are implicit in the model, being picked up by the exogenous factors that are included in the regression. This model has the advantages that it is not subject to potential endogeneity bias from including endogenous explanatory variables, and estimates the full impact of exogenous factors. It has the disadvantage of not estimating the impact of the endogenous explanatory variables.

In addition to the tests discussed above, we tested for multicollinearity using variance inflation factors (VIF), which measure the extent to which the variances of estimated coefficients are increased by multicollinearity among the explanatory variables (Mukherjee, et al. 1998). A common rule of thumb is that VIF's greater than 10 represent a serious concern. In our results we report coefficients that have VIF's greater than 10 (this is rare in the models combining all regions). We use the Huber-White covariance estimator (StataCorp 2003), which is robust to

heteroskedasticity. We also adjusted the covariance estimates for clustering of the two-stage sample, which allows for non-independence of error terms across observations within each primary sampling unit, and accounts for the sample stratification (Ibid.).

Annex 3. Determinants of Crop Yields

Table 1. Determinants of Maize Yield (ln(qq/ha))

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
Belg season (cf. Meher season)	-0.114	-0.091	-0.111	-0.121
Agricultural Training and Extension				
CBO providing agricultural training in village	0.354**	0.359**	0.276	0.298**
ln(number of extension contacts 1997-2002)	0.075	0.084*	0.048	0.084
Human Capital				
Female hh head (cf. male hh head)	0.147			0.137
ln (age of hh head)	-0.126			-0.089
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	-0.215			-0.206
- Paid off-farm work	-0.228			-0.197
- Ill/disabled	-0.025			-0.084
- No occupation/student	0.122			0.069
- Pastoralist/herding	-0.210			-0.225
ln(median education of males+1)	-0.002			0.023
ln(median education of females+1)	-0.076			-0.108
ln(hhsize)	0.086			0.113*
Proportion of dependents	-0.417**	-0.361**	-0.389*	-0.384*
Assets				
ln(land area owned (ha)+1)	0.161			0.188
ln(no. of oxen owned+1)	0.072			0.086
ln(no. other cattle owned+1)	0.076*	0.106**	0.049	0.080*
ln(no. small ruminants owned+1)	0.001			-0.009
ln(value of durables owned (EB)+1)	0.015			0.022
ln(value of tools owned (EB)+1)	0.022			0.032
Own a functioning radio (yes/no)	0.029			0.021
Plot Characteristics				
ln(area of plot (ha)+1)	-0.600***	-0.536***	-0.576***	-0.655***
How plot acquired (cf. inherited)				
- PA allocation	0.120			0.109
- Gift	0.258*			0.268*
- Rented	0.184			0.253
- Sharecropped/borrowed	-0.755			-0.696
Cultivated field (cf. homestead)	0.030	0.000	0.140	0.025
ln(walking time to plot (minutes) + 1)	-0.027	-0.026	-0.001	-0.041
Land Investments on Plot				
- Stone terrace	0.051	0.049	0.175	0.058
- Soil bund	0.043	0.051	0.074	0.049
- Check dam	0.465***	0.451***	0.392	0.455***
- Drainage ditch	0.377	0.371	0.305	0.491
- Live fence	-0.004	-0.056	0.012	0.078
- Stones cleared	0.025	-0.023	-0.090	0.008
- Leveled	0.094	0.095	-0.147	0.062
- Irrigated	0.185	0.108	0.082	0.180
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.007	0.013	-0.222	
- ln(oxen days/ha + 1)	0.049*	0.062**	0.000	
- ln(seed qq/ha + 1)	0.261***	0.259***	0.245	
- Improved seed used (yes/no)	0.142	0.148	0.724	

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
- DAP used (yes/no)	0.230	0.301	3.015**	
- Urea used (yes/no)	0.190	0.181	-0.720	
- Chemical pesticide used (yes/no)	0.013	0.012	1.242	
- Burning used (yes/no)	-0.493***	-0.499***	-0.238	
- Manuring used (yes/no)	0.169**	0.199***	0.523	
- Green manure used (yes/no)	-0.211	-0.206	-1.438	
Intercept	1.557***	1.533***	1.058**	1.523***
No. of observations	1052	1057	1051	1052
R^2	0.3273	0.3129		0.2987
Wald test of variables excluded from OLS short model		p=0.6810		
Hansen's J test of overidentifying restrictions			p=0.4862	
Relevance tests of instrumental variables				
- ln(wage labor days/ha + 1)			p=0.0115	
- ln(oxen days/ha + 1)			p=0.0000	
- ln(seed qq/ha + 1)			p=0.0000	
- Improved seed used (yes/no)			p=0.0000	
- DAP used (yes/no)			p=0.0006	
- Urea used (yes/no)			p=0.0142	
- Chemical pesticide used (yes/no)			p=0.0727	
- Burning used (yes/no)			p=0.0000	
- Manuring used (yes/no)			p=0.0002	
- Green manure used (yes/no)			p=0.0000	
Hausman test of OLS vs. IV models			p=1.0000	

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 2. Determinants of Maize Yield by Socioeconomic Region (ln(qq/ha)) (OLS)

Variable[a]	Harerghe	Borena and Filtu	Tigray
Belg season (cf. Meher season)	-0.549**	-0.094	-0.528
Agricultural Training and Extension			
CBO providing agricultural training in village		0.349***	
ln(number of extension contacts 1997-2002)	0.245*	0.231**	-0.129
Human Capital			
Female hh head (cf. male hh head)	0.703**	0.020	0.202
ln (age of hh head)	0.093	-0.154	-0.124
Primary occupation of hh head (cf. cultivation)			
- Unpaid domestic/other work	-0.676*	-0.185	-0.200
- Paid off-farm work	0.131	-0.161	-0.496**
- Ill/disabled	-0.476	-0.071	0.126
- No occupation/student	-0.032	0.169	-0.043
- Pastoralist/herding		-0.363	1.147
ln(median education of males+1)	-0.005	-0.016	-0.034
ln(median education of females+1)	-0.227*	0.017	-0.136
ln(hhsize)	0.130	-0.028	0.029
Proportion of dependents	-0.132	-0.609*	-0.615**
Assets			
ln(land area owned (ha)+1)	-0.153	0.803*	-1.406***
ln(no. of oxen owned+1)	-0.037	0.187*	0.028
ln(no. other cattle owned+1)	0.222**	0.024	0.058
ln(no. small ruminants owned+1)	0.027	0.002	0.020
ln(value of durables owned (EB)+1)	0.054	0.004	-0.006
ln(value of tools owned (EB)+1)	0.093	-0.072*	0.093
Own a functioning radio (yes/no)	0.136	-0.276*	0.313*
Plot Characteristics			
ln(area of plot (ha)+1)	-0.633***	-0.555***	-0.501***
How plot acquired (cf. inherited)			
- PA allocation	-0.011	0.215	0.116
- Gift	0.221	0.440	-0.264
- Rented		-0.183	1.003*
- Sharecropped/borrowed		-0.396	-2.843***
Cultivated field (cf. homestead)	0.409*	0.523**	-0.693***
ln(walking time to plot (minutes)+1)	-0.026	-0.016	0.096*
Land Investments on Plot			
- Stone terrace	0.070	-0.028	-0.062
- Soil bund	0.067	-0.395	0.156
- Check dam	0.208	0.724**	1.359***
- Drainage ditch	0.098	0.900***	-1.388
- Live fence	-0.005	0.101	-0.168
- Stones cleared	0.042	-0.543	-0.104
- Leveled	-0.080	0.336	0.527**
- Irrigated	0.285	0.196	0.578
Inputs/Land Management Practices			
- ln(wage labor days/ha + 1)	-0.246*	0.013	0.008
- ln(oxen days/ha + 1)	0.017	0.131***	0.113
- ln(seed qq/ha + 1)	0.362**	0.211***	0.383**
- Improved seed used (yes/no)	0.063	0.006	0.226
- DAP used (yes/no)	0.858**	-0.687	-0.172
- Urea used (yes/no)	0.443	2.013***	0.253

Variable[a]	Harerghe	Borena and Filtu	Tigray
- Chemical pesticide used (yes/no)	1.089***	0.231	-0.987
- Burning used (yes/no)	-0.535***	-0.538	-0.018
- Manuring used (yes/no)	0.158	0.400**	0.166
- Green manure used (yes/no)	0.157		0.290
Intercept	-1.141	1.020	1.615
No. of observations	315	446	197
R^2	0.4469	0.2221	0.6243

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 3. Determinants of Wheat Yield (ln(qq/ha))

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
Belg season (cf. Meher season)	-0.534**	-0.510**	-0.545**	-0.629**
Agricultural Training and Extension				
CBO providing agricultural training in village	0.756**	0.745**	0.764**	0.637*
ln(number of extension contacts 1997-2002)	0.027	0.035	0.028	0.014
Human Capital				
Female hh head (cf. male hh head)	0.054			0.059
ln (age of hh head)	-0.082			-0.048
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	-0.122	-0.103	-0.109	-0.065
- Paid off-farm work	-0.323**	-0.275**	-0.251	-0.338**
- Ill/disabled	0.465*	0.423*	0.407	0.278
- No occupation/student	0.007	0.008	0.003	0.025
- Pastoralist/herding	0.233	0.234	0.288	0.461**
ln(median education of males+1)	-0.097**	-0.090*	-0.087*	-0.102**
ln(median education of females+1)	-0.112*	-0.102	-0.127	-0.099
ln(hhsize)	0.103			0.106
Proportion of dependents	-0.152	-0.151	-0.149	-0.055
Assets				
ln(area owned (ha)+1)	-0.369*			-0.358*
ln(no. of oxen owned+1)	0.059			0.085
ln(no. other cattle owned+1)	0.136**	0.156**	0.111	0.155**
ln(no. small ruminants owned+1)	0.038			0.041
ln(value of durables owned (EB)+1)	0.001			0.005
ln(value of tools owned (EB)+1)	0.087***	0.091***	0.079**	0.105***
Own a functioning radio (yes/no)	-0.001			0.041
Plot Characteristics				
ln(land area of plot (ha)+1)	-0.433***	-0.491***	-0.541***	-0.576***
How plot acquired (cf. inherited)				
- PA allocation	0.103			0.057
- Gift	0.157			0.028
- Rented	0.288			0.271
- Sharecropped/borrowed	0.360			0.379
Cultivated field (cf. homestead)	-0.233	-0.202	-0.154	-0.271
ln(walking time to plot (minutes)+1)	0.033	0.025	0.027	0.029
Land Investments on Plot				
- Stone terrace	-0.151**	-0.160**	-0.177**	-0.211***
- Soil bund	-0.137	-0.135	-0.137	-0.116
- Check dam	0.249	0.214	-0.067	0.400**
- Drainage ditch	-0.147	-0.179	-0.192	-0.061
- Live fence	0.055	0.049	0.114	0.110
- Stones cleared	-0.162	-0.154	-0.188	-0.072
- Leveled	0.112	0.127	0.183	0.118
- Irrigated	0.012	0.015	-0.075	-0.027
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.010	0.011	-0.057	
- ln(oxen days/ha + 1)	0.144***	0.145***	0.104	
- ln(seed qq/ha + 1)	0.256***	0.248***	0.212	
- Improved seed used (yes/no)	-0.068	-0.063	0.112	
- DAP used (yes/no)	0.294**	0.294**	-0.421	
- Urea used (yes/no)	0.152	0.164*	0.329	

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
- Chemical pesticide used (yes/no)	0.440**	0.437*	0.908	
- Burning used (yes/no)	0.198	0.220	1.218	
- Manuring used (yes/no)	0.062	0.073	0.376	
- Green manure used (yes/no)	-0.481	-0.493	-1.625	
Intercept	-0.005	-0.586*	-0.701	-0.166
No. of observations	1123	1123	1122	1123
R^2	0.4142	0.4087		0.3681
Wald test of variables excluded from OLS short model		p=0.6237		
Hansen's J test of overidentifying restrictions			p=0.2141	
Relevance tests of instrumental variables				
- ln(wage labor days/ha + 1)			p=0.0144	
- ln(oxen days/ha + 1)			p=0.0000	
- ln(seed qq/ha + 1)			p=0.0000	
- Improved seed used (yes/no)			p=0.0057	
- DAP used (yes/no)			p=0.0001	
- Urea used (yes/no)			p=0.0000	
- Chemical pesticide used (yes/no)			p=0.5183	
- Burning used (yes/no)			p=0.0000	
- Manuring used (yes/no)			p=0.0000	
- Green manure used (yes/no)			p=0.0527	
Hausman test of OLS vs. IV models			NE	

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

NE means Hausman test not estimable because test statistic is negative.

Table 4. Determinants of Wheat Yield by Socioeconomic Region (ln(qq/ha)) (OLS)

Variable[a]	Harerghe	Borena and Filtu	South Gonder/Wello	Tigray
Belg season (cf. Meher season)	-0.242	-0.662**		1.489***
Agricultural Training and Extension				
CBO providing agricultural training in village		0.550*		
ln(number of extension contacts 1997-2002)	0.307	0.504**	0.070	-0.023
Human Capital				
Female hh head (cf. male hh head)	-0.686	0.011	0.052	0.068
ln (age of hh head)	-0.481	-0.069	-0.451*	-0.167
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	1.213**	0.091	-0.040	-0.128
- Paid off-farm work	0.619	-0.948**	-0.359	-0.241
- Ill/disabled	1.183		0.580*	0.244
- No occupation/student	0.609*	-0.553	0.138	0.017
- Pastoralist/herding		1.196*	1.134*	0.196
ln(median education of males+1)	-0.300**	-0.043	-0.153	-0.096*
ln(median education of females+1)	-0.040	0.039	0.118	-0.075
ln(hhsize)	0.285	0.169	0.107	0.037
Proportion of dependents	-1.004*	-0.994	0.633*	-0.194
Assets				
ln(land area owned (ha)+1)	-0.934	-0.563	-0.824	-0.900***
ln(no. of oxen owned+1)	1.030***	0.089	-0.247	-0.042
ln(no. other cattle owned+1)	0.728***	-0.360***	0.391**	0.084
ln(no. small ruminants owned+1)	-0.190	0.077	0.036	0.100**
ln(value of durables owned (EB)+1)	-0.151*	-0.240**	0.067*	0.019
ln(value of tools owned (EB)+1)	-0.025	-0.063	-0.019	0.110**
Own a functioning radio (yes/no)	0.382	0.852***	-0.381*	0.004
Plot Characteristics				
ln(area of plot (ha)+1)	-0.717***	0.073	-0.462***	-0.232***
How plot acquired (cf. inherited)				
- PA allocation	-0.102	-1.790***	0.570	0.043
- Gift	-0.296		0.531	-0.001
- Rented	-0.592		0.886*	-0.199
- Sharecropped/borrowed	-0.445	-1.249*		0.498
Cultivated field (cf. homestead)	-0.599	0.262	-0.012	-0.106
ln(walking time to plot (minutes)+1)	0.009	-0.052	0.117*	0.024
Land Investments on Plot				
- Stone terrace	-0.309	-0.844*	0.042	-0.113
- Soil bund	-0.484*	-1.379**	-1.042	-0.024
- Check dam	0.143	-0.387	0.626	-0.185
- Drainage ditch	-0.148	0.960***	0.024	-0.208
- Live fence	-0.495	-1.045		0.059
- Stones cleared	0.071		-0.209	-0.258*
- Leveled	1.003***	1.564**	-1.284*	-0.042
- Irrigated	1.664**		-0.386	0.245
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.079	0.666***	-0.026	-0.061
- ln(oxen days/ha + 1)	0.035	0.283**	0.247***	0.119***
- ln(seed qq/ha + 1)	0.256*	0.046	-0.053	0.399***
- Improved seed used (yes/no)	0.561	-0.058	0.055	-0.155
- DAP used (yes/no)	-0.285	-1.399*	-0.767	0.123
- Urea used (yes/no)	-0.060	1.005*	0.352	0.223**

Variable[a]	Harerghe	Borena and Filtu	South Gonder/Wello	Tigray
- Chemical pesticide used (yes/no)	-1.747*	0.742***	-0.112	0.644*
- Burning used (yes/no)	0.358		-0.879**	0.291**
- Manuring used (yes/no)	-0.206	1.141	0.276	0.086
- Green manure used (yes/no)	-0.206		-0.557	-0.178
Intercept	1.027	5.172***	1.279	1.213**
No. of observations	127	117	216	532
R^2	0.6388	0.4740	0.3522	0.5266

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 5. Determinants of Sorghum Yield (ln(qq/ha))

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
Belg season (cf. Meher season)	-0.421	-0.471**	-0.572**	-0.372
Agricultural Training and Extension				
CBO providing agricultural training in village	1.548***[m]	1.453***	1.396***	1.764***
ln(number of extension contacts 1997-2002)	0.017	0.051	0.110	0.007
Human Capital				
Female hh head (cf. male hh head)	0.409**	0.308**	0.466	0.386***
ln (age of hh head)	0.496***	0.462***	0.536***	0.521***
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	-0.194	-0.204	-0.422	-0.165
- Paid off-farm work	-0.274	-0.300	-0.423	-0.174
- Ill/disabled	-0.280	-0.252	-0.403	-0.152
- No occupation/student	0.092	0.082	0.059	0.125
- Pastoralist/herding	0.682**	0.548*	0.448	0.805**
ln(median education of males+1)	-0.193**	-0.186**	-0.204**	-0.191**
ln(median education of females+1)	-0.113			-0.092
ln(hhsize)	-0.039			-0.045
Proportion of dependents	-0.521**	-0.496**	-0.406	-0.548***
Assets				
ln(land area owned (ha)+1)	0.291			0.296
ln(no. of oxen owned+1)	0.148			0.174
ln(no. other cattle owned+1)	0.083			0.077
ln(no. small ruminants owned+1)	-0.046			-0.051
ln(value of durables owned (EB)+1)	0.067***	0.088***	0.070**	0.070***
ln(value of tools owned (EB)+1)	0.045			0.041
Own a functioning radio (yes/no)	0.189			0.234*
Plot Characteristics				
ln(area of plot (ha)+1)	-0.723***	-0.652***	-0.453**	-0.811***
How plot acquired (cf. inherited)				
- PA allocation	0.055	0.082	0.087	0.009
- Gift	0.224	0.184	0.093	0.175
- Rented	0.954***	0.973***	0.965***	0.875***
- Sharecropped/borrowed				
Cultivated field (cf. homestead)	0.158	0.208	0.411	0.144
ln(walking time to plot (minutes)+1)	-0.018	-0.024	-0.061	-0.026
Land Investments on Plot				
- Stone terrace	-0.244*	-0.257**	-0.385*	-0.203
- Soil bund	-0.047	-0.052	-0.182	0.006
- Check dam	-0.144	-0.157	-0.156	-0.124
- Drainage ditch	0.496	0.472*	0.625	0.350
- Live fence	-0.588**	-0.587**	-0.642*	-0.491
- Stones cleared	-0.181	-0.164	0.028	-0.158
- Leveled	-0.264	-0.314	-0.567	-0.243
- Irrigated	-0.176	-0.074	0.010	-0.245
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.067	0.067	0.084	
- ln(oxen days/ha + 1)	0.128***	0.125***	0.241	
- ln(seed qq/ha + 1)	0.254**	0.288**	1.025	
- Improved seed used (yes/no)	0.498	0.526	1.620	
- DAP used (yes/no)	0.310	0.323	-0.360	
- Urea used (yes/no)	-0.054	-0.136	-0.240	

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
- Chemical pesticide used (yes/no)	-0.010	-0.167	-0.952	
- Burning used (yes/no)	-0.279	-0.275*	0.380	
- Manuring used (yes/no)	0.117	0.122	-0.290	
- Green manure used (yes/no)	0.161	0.187	1.947	
Intercept	-1.146	-0.656	-1.202	-1.025
No. of observations	444	444	442	444
R^2	0.4748	0.4600		0.4498
Wald test of variables excluded from OLS short model		p=0.1980		
Hansen's J test of overidentifying restrictions			p=0.3665	
Relevance tests of instrumental variables				
- ln(wage labor days/ha + 1)			p=0.0000	
- ln(oxen days/ha + 1)			p=0.0325	
- ln(seed qq/ha + 1)			p=0.0000	
- Improved seed used (yes/no)			p=0.5232	
- DAP used (yes/no)			p=0.4292	
- Urea used (yes/no)			p=0.0111	
- Chemical pesticide used (yes/no)			p=0.0390	
- Burning used (yes/no)			p=0.1498	
- Manuring used (yes/no)			p=0.0039	
- Green manure used (yes/no)			p=0.0205	
Hausman test of OLS vs. IV models			NE	

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

NE means Hausman test not estimable because test statistic is negative.

Table 6. Determinants of Sorghum Yield by Socioeconomic Region (ln(qq/ha)) (OLS)

Variable[a]	Harerghe	Tigray
Belg season (cf. Meher season)		
Agricultural Training and Extension		
CBO providing agricultural training in village		
ln(number of extension contacts 1997-2002)	0.018	-0.285**
Human Capital		
Female hh head (cf. male hh head)	0.208	0.104
ln (age of hh head)	0.667***	-0.058
Primary occupation of hh head (cf. cultivation)		
- Unpaid domestic/other work	-0.296	0.018
- Paid off-farm work	-0.384	-0.446
- Ill/disabled	-0.495*	0.636***
- No occupation/student	0.101	-0.599*
- Pastoralist/herding		-0.283
ln(median education of males+1)	-0.118	-0.225**
ln(median education of females+1)	-0.481**	0.612***
ln(hhsize)	-0.132	0.535***
Proportion of dependents	-0.555**	-1.099***
Assets		
ln(land area owned (ha)+1)	0.586*	-1.056
ln(no. of oxen owned+1)	0.583***	-0.500*
ln(no. other cattle owned+1)	0.211*	-0.038
ln(no. small ruminants owned+1)	0.017	0.050
ln(value of durables owned (EB)+1)	0.057	0.017
ln(value of tools owned (EB)+1)	0.113**	0.108***
Own a functioning radio (yes/no)	0.151	-0.054
Plot Characteristics		
ln(area of plot (ha)+1)	-0.802***	-0.982***
How plot acquired (cf. inherited)		
- PA allocation	-0.051	-0.301**
- Gift	0.382**	-0.968*
- Rented		1.928**
- Sharecropped/borrowed		
Cultivated field (cf. homestead)	-0.028	0.860
ln(walking time to plot (minutes)+1)	-0.043	-0.128
Land Investments on Plot		
- Stone terrace	-0.122	-0.270
- Soil bund	-0.199**	-0.106
- Check dam	-0.552**	-0.683
- Drainage ditch	-0.322	
- Live fence	-0.529	-0.264
- Stones cleared	-0.210	0.064
- Leveled	-0.259	-0.523
- Irrigated	-0.118	-2.257**
Inputs/Land Management Practices		
- ln(wage labor days/ha + 1)	-0.022	-0.310
- ln(oxen days/ha + 1)	0.121**	-0.093
- ln(seed qq/ha + 1)	0.318**	0.214
- Improved seed used (yes/no)	0.901**	
- DAP used (yes/no)	2.367***	0.076
- Urea used (yes/no)	0.776	-0.643*
- Chemical pesticide used (yes/no)	-0.451	-0.716*

Variable[a]	Harerghe	Tigray
- Burning used (yes/no)	-0.429	-0.711**
- Manuring used (yes/no)	0.010	-0.376
- Green manure used (yes/no)	0.386	-1.366**
Intercept	-2.706**	2.915*
No. of observations	238	105
R^2	0.5903	0.7392

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 7. Determinants of Teff Yield (ln(qq/ha))

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
Belg season (cf. Meher season)	-0.280	-0.248	-0.347	-0.271
Agricultural Training and Extension				
CBO providing agricultural training in village	0.352	0.318	0.723**	0.407*
ln(number of extension contacts 1997-2002)	-0.005	0.000	0.034	0.019
Human Capital				
Female hh head (cf. male hh head)	0.075			0.085
ln (age of hh head)	-0.108			-0.067
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	0.004	0.064	0.033	-0.038
- Paid off-farm work	-0.416**	-0.420**	-0.424*	-0.374**
- Ill/disabled	-0.024	-0.075	0.057	-0.014
- No occupation/student	0.010	0.023	0.145	0.008
- Pastoralist/herding	-1.400*	-1.326	-1.278	-1.455*
ln(median education of males+1)	0.017			0.025
ln(median education of females+1)	-0.045			-0.038
ln(hhsize)	0.057			0.062
Proportion of dependents	0.106			0.119
Assets				
ln(land area owned (ha)+1)	-0.271			-0.221
ln(no. of oxen owned+1)	0.255**	0.278***	0.301**	0.281***
ln(no. other cattle owned+1)	0.025			0.038
ln(no. small ruminants owned+1)	0.024			0.013
ln(value of durables owned (EB)+1)	-0.004			0.002
ln(value of tools owned (EB)+1)	0.105***	0.111***	0.103**	0.102***
Own a functioning radio (yes/no)	0.096			0.102
Plot Characteristics				
ln(area of plot (ha)+1)	-0.619***	-0.666***	-0.649***	-0.698***
How plot acquired (cf. inherited)				
- PA allocation	0.186			0.128
- Gift	-0.050			-0.016
- Rented	0.005			0.015
- Sharecropped/borrowed	0.531			0.455
Cultivated field (cf. homestead)	-0.582***	-0.527***	-0.537**	-0.527***
ln(walking time to plot (minutes)+1)	-0.038	-0.044*	-0.086**	-0.061**
Land Investments on Plot				
- Stone terrace	-0.051	-0.029	-0.116	-0.079
- Soil bund	0.037	0.031	-0.060	0.073
- Check dam	-0.282	-0.299	-0.183	-0.178
- Drainage ditch	0.129	0.101	0.224	0.329
- Live fence	0.167	0.135	-0.003	0.188
- Stones cleared	-0.116	-0.119	-0.130	-0.124
- Leveled	-0.100	-0.085	0.028	-0.005
- Irrigated	-0.222	-0.200	-0.223	-0.260
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.075*	0.075**	-0.143	
- ln(oxen days/ha + 1)	0.111***	0.108***	-0.002	
- ln(seed qq/ha + 1)	0.038	0.049	0.584	
- Improved seed used (yes/no)	0.615**	0.589**	-2.113	
- DAP used (yes/no)	0.016	0.020	0.236	
- Urea used (yes/no)	0.175	0.200	-0.030	

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
- Chemical pesticide used (yes/no)	0.683***	0.628***	-0.547	
- Burning used (yes/no)	0.261	0.264	0.415	
- Manuring used (yes/no)	0.131	0.122	-0.091	
- Green manure used (yes/no)	0.155	0.124	-0.768	
Intercept	1.668**	0.179	0.459	0.275
No. of observations	925	926	923	925
R^2	0.3926	0.3864		0.3566
Wald test of variables excluded from OLS short model		p=0.9572		
Hansen's J test of overidentifying restrictions			p=0.2612	
Relevance tests of instrumental variables				
- ln(wage labor days/ha + 1)			p=0.0002	
- ln(oxen days/ha + 1)			p=0.0000	
- ln(seed qq/ha + 1)			p=0.0000	
- Improved seed used (yes/no)			p=0.0232	
- DAP used (yes/no)			p=0.0001	
- Urea used (yes/no)			p=0.0070	
- Chemical pesticide used (yes/no)			p=0.0591	
- Burning used (yes/no)			p=0.0010	
- Manuring used (yes/no)			p=0.0001	
- Green manure used (yes/no)			p=0.3094	
Hausman test of OLS vs. IV models			p=1.0000	

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 8. Determinants of Teff Yield by Socioeconomic Region (ln(qq/ha)) (OLS)

Variable[a]	Eastern Shewa	Borena and Filtu	South Gonder/Wello	Tigray
Belg season (cf. Meher season)		-0.197		
Agricultural Training and Extension				
CBO providing agricultural training in village		0.170		
ln(number of extension contacts 1997-2002)	0.200**	0.155	0.040	-0.063
Human Capital				
Female hh head (cf. male hh head)	-0.430	1.663**	-0.285	-0.031
ln (age of hh head)	-0.520	0.108	-0.269	-0.247
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	-1.251	-0.606	0.394	0.265
- Paid off-farm work			-0.486	-0.193
- Ill/disabled	0.722		-0.405	0.348
- No occupation/student		-0.464	0.109	0.182
- Pastoralist/herding		-3.156***	-0.436	-0.136
ln(median education of males+1)	-0.055	-0.042	-0.059	-0.035
ln(median education of females+1)	0.581**	0.056	-0.099	-0.014
ln(hhsize)	0.379	-0.190	0.069	0.078
Proportion of dependents	-0.733	-1.357*	0.681*	-0.093
Assets				
ln(land area owned (ha)+1)	-0.597	1.024	-0.327	-0.681*
ln(no. of oxen owned+1)	0.622*	-0.188	0.103	0.192
ln(no. other cattle owned+1)	0.031	0.196	0.237	-0.090
ln(no. small ruminants owned+1)	-0.030	-0.527**	0.145**	0.078
ln(value of durables owned (EB)+1)	-0.019	-0.068	-0.020	0.014
ln(value of tools owned (EB)+1)	0.028	0.124	0.022	0.101**
Own a functioning radio (yes/no)	-1.143**	0.515	0.091	0.052
Plot Characteristics				
ln(area of plot (ha)+1)	-0.794**	-0.652**	-0.490***	-0.584***
How plot acquired (cf. inherited)				
- PA allocation	0.398	-5.503***[m]	1.606	-0.015
- Gift	0.499	-8.708***[m]	1.003	0.813**
- Rented	0.446	-5.700***	1.612*	-0.377*
- Sharecropped/borrowed		-6.742***		0.472
Cultivated field (cf. homestead)	-0.321	-0.962*	-0.400	-0.381
ln(walking time to plot (minutes)+1)	-0.225*	-0.100	-0.030	0.006
Land Investments on Plot				
- Stone terrace	-0.372		-0.103	-0.029
- Soil bund	-0.048	-1.436*	0.421	0.042
- Check dam	0.364	0.739	0.852**	-0.372
- Drainage ditch	1.260**	-0.674*	-0.281	-0.503
- Live fence	-0.005	8.208**		0.127
- Stones cleared	0.404	0.561	-0.321	-0.269
- Leveled		-0.386[m]	-0.258	-0.133
- Irrigated	0.123		0.265	-0.300
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	0.293**		0.007	0.058
- ln(oxen days/ha + 1)	-0.043	-0.042	0.126	0.147***
- ln(seed qq/ha + 1)	0.226	0.074	-0.065	0.034
- Improved seed used (yes/no)	2.773***	-0.201		0.650**
- DAP used (yes/no)	-0.168		0.147	-0.110
- Urea used (yes/no)	-0.545*	-4.182**		0.334**

Variable[a]	Eastern Shewa	Borena and Filtu	South Gonder/Wello	Tigray
- Chemical pesticide used (yes/no)	0.720	1.868*	-0.191	0.532*
- Burning used (yes/no)		-2.846*[m]	0.147	0.256
- Manuring used (yes/no)	0.385**	0.453	0.068	0.106
- Green manure used (yes/no)			0.372	-0.043
Intercept	2.986	9.951***	0.254	0.514
No. of observations	103	123	203	493
R^2	0.7102	0.6103	0.4696	0.4533

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 9. Determinants of Barley Yield (ln(qq/ha))

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
Belg season (cf. Meher season)	0.207	0.183	0.116	0.235
Agricultural Training and Extension				
CBO providing agricultural training in village	0.422	0.424	0.558	0.253
ln(number of extension contacts 1997-2002)	-0.064	-0.063*	-0.035	-0.102*
Human Capital				
Female hh head (cf. male hh head)	-0.184	-0.169	-0.225	-0.198
ln (age of hh head)	-0.097			-0.084
Primary occupation of hh head (cf. cultivation)				
- Unpaid domestic/other work	0.218	0.210	0.143	0.234
- Paid off-farm work	-0.240**	-0.231*	-0.239	-0.206
- Ill/disabled	0.364*	0.277	-0.171	0.351
- No occupation/student	0.473***	0.440***	0.335*	0.489***
- Pastoralist/herding	-0.738	-0.630	0.168	-0.931
ln(median education of males+1)	-0.075	-0.073	-0.042	-0.083
ln(median education of females+1)	-0.015			-0.020
ln(hhsize)	-0.030			-0.048
Proportion of dependents	-0.121			-0.126
Assets				
ln(land area owned (ha)+1)	-0.243			-0.233
ln(no. of oxen owned+1)	0.091			0.131
ln(no. other cattle owned+1)	0.086	0.106*	0.041	0.122*
ln(no. small ruminants owned+1)	0.051			0.071
ln(value of durables owned (EB)+1)	0.044***	0.046***	0.062***	0.044***
ln(value of tools owned (EB)+1)	-0.003			0.000
Own a functioning radio (yes/no)	0.121	0.129	0.101	0.115
Plot Characteristics				
ln(area of plot (ha)+1)	-0.469***	-0.504***	-0.595***	-0.622***
How plot acquired (cf. inherited)				
- PA allocation	-0.117	-0.157*	-0.239*	-0.140
- Gift	-0.366**	-0.357**	-0.149	-0.373*
- Rented	-0.363*	-0.375**	-0.148	-0.338*
- Sharecropped/borrowed	0.076	0.074	-0.019	0.099
Cultivated field (cf. homestead)	-0.373***	-0.372***	-0.377	-0.288*
ln(walking time to plot (minutes)+1)	0.018	0.017	0.004	0.017
Land Investments on Plot				
- Stone terrace	0.067	0.072	0.033	0.068
- Soil bund	0.217**	0.221**	0.158	0.306***
- Check dam	0.225	0.239	0.359	0.240
- Drainage ditch	0.175	0.170	0.616	0.109
- Live fence	-0.140	-0.148	-0.028	-0.032
- Stones cleared	-0.127	-0.120	-0.005	-0.121
- Leveled	-0.138	-0.128	-0.122	-0.083
- Irrigated	0.054	0.067	-0.037	0.083
Inputs/Land Management Practices				
- ln(wage labor days/ha + 1)	-0.024	-0.024	0.032	
- ln(oxen days/ha + 1)	0.156***	0.156***	0.150	
- ln(seed qq/ha + 1)	0.269***	0.265***	0.128	
- Improved seed used (yes/no)	0.698*	0.700*	0.940	
- DAP used (yes/no)	0.020	0.011	-1.687	
- Urea used (yes/no)	0.132	0.144	0.191	

Variable[a]	OLS Full Model	OLS Short Model	IV Model	RF Model
- Chemical pesticide used (yes/no)	0.401**	0.397**	-0.911	
- Burning used (yes/no)	-0.032	-0.033	1.737	
- Manuring used (yes/no)	0.175**	0.186**	0.274	
- Green manure used (yes/no)	-1.412***	-1.451***	-4.254***	
Intercept	0.279	-0.374	-0.410	0.395
No. of observations	1080	1080	1077	1080
R^2	0.4171	0.4139		0.3427
Wald test of variables excluded from OLS short model		0.5307		
Hansen's J test of overidentifying restrictions			0.9118	
Relevance tests of instrumental variables				
- ln(wage labor days/ha + 1)			0.0001	
- ln(oxen days/ha + 1)			0.0000	
- ln(seed qq/ha + 1)			0.0000	
- Improved seed used (yes/no)			0.2710	
- DAP used (yes/no)			0.2443	
- Urea used (yes/no)			0.0167	
- Chemical pesticide used (yes/no)			0.4244	
- Burning used (yes/no)			0.0000	
- Manuring used (yes/no)			0.0000	
- Green manure used (yes/no)			0.0000	
Hausman test of OLS vs. IV models			1.0000	

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 10. Determinants of Barley Yield by Socioeconomic Region (ln(qq/ha)) (OLS)

Variable[a]	South Gonder/Wello	Tigray
Belg season (cf. Meher season)	0.274	0.329
Agricultural Training and Extension		
CBO providing agricultural training in village		
ln(number of extension contacts 1997-2002)	-0.148*	-0.058
Human Capital		
Female hh head (cf. male hh head)	-0.081	-0.273**
ln (age of hh head)	-0.514*	0.071
Primary occupation of hh head (cf. cultivation)		
- Unpaid domestic/other work	-0.120	0.577***
- Paid off-farm work	-0.349	0.002
- Ill/disabled	0.594	0.281
- No occupation/student	-0.394	0.530***
- Pastoralist/herding	1.752**	0.294
ln(median education of males+1)	-0.004	-0.074
ln(median education of females+1)	0.254	-0.037
ln(hhsize)	0.266	0.005
Proportion of dependents	0.547	-0.244
Assets		
ln(land area owned (ha)+1)	-0.488	-0.638**
ln(no. of oxen owned+1)	-0.356**	0.119
ln(no. other cattle owned+1)	0.114	0.136
ln(no. small ruminants owned+1)	0.176	0.005
ln(value of durables owned (EB)+1)	0.047	0.035
ln(value of tools owned (EB)+1)	0.086	-0.006
Own a functioning radio (yes/no)	-0.071	0.138
Plot Characteristics		
ln(area of plot (ha)+1)	-0.608***	-0.309***
How plot acquired (cf. inherited)		
- PA allocation	-0.099	-0.008
- Gift	-0.530	-0.061
- Rented	-0.124	-0.560**
- Sharecropped/borrowed	-1.758*	0.203
Cultivated field (cf. homestead)	-0.567**	-0.314*
ln(walking time to plot (minutes)+1)	0.084**	0.015
Land Investments on Plot		
- Stone terrace	-0.066	0.040
- Soil bund	0.287	0.287***
- Check dam	0.426	0.585***
- Drainage ditch	0.068	0.149
- Live fence		-0.274*
- Stones cleared	-0.345	-0.041
- Leveled	0.317	-0.108
- Irrigated	0.108	-0.056
Inputs/Land Management Practices		
- ln(wage labor days/ha + 1)	-0.220*	0.090
- ln(oxen days/ha + 1)	0.098	0.162***
- ln(seed qq/ha + 1)	0.241	0.235***
- Improved seed used (yes/no)		0.332
- DAP used (yes/no)		0.020
- Urea used (yes/no)	0.017	0.096

Variable[a]	South Gonder/Wello	Tigray
- Chemical pesticide used (yes/no)	1.045***	0.349
- Burning used (yes/no)	-1.725***	-0.035
- Manuring used (yes/no)	0.273	0.185*
- Green manure used (yes/no)	-1.294*	-0.657
Intercept	1.343	0.371
No. of observations	234	585
R^2	0.3893	0.4667

*, **, *** mean coefficient is statistically significant at 10%, 5%, and 1% level, respectively. All coefficients and standard errors are adjusted for stratification and clustering of sample, and robust to heteroscedasticity.

[a] The regressions also included dummy variables for each woreda in the sample (excluding one as the comparator), and indicators of the plot slope, soil type and altitude. These results are not reported to save space. Complete results available upon request.

[m] means multicollinearity is a serious concern for the indicated coefficient (variance inflation factor >10).

Table 11. Summary of Determinants of Cereal Yields

Variable	Maize	Wheat	Sorghum	Teff	Barley
Belg season (cf. Meher season)	0	---	--	0	0
Agricultural Training and Extension					
CBO providing agricultural training in village	++	+++	+++	++	0
ln(number of extension contacts 1997-2002)	+	0	0	0	--
Human Capital					
Female hh head (cf. male hh head)	0	0	++	0	0
ln (age of hh head)	0	0	+++	0	0
Primary occupation of hh head					
- Unpaid domestic/other work	0	0	0	0	0
- Paid off-farm work	0	--	0	---	--
- Ill/disabled	0	+	0	0	+
- No occupation/student	0	0	0	0	+++
- Pastoralist/herding	0	+	++	-	0
ln(median education of males+1)	0	---	---	0	0
ln(median education of females+1)	0	-	0	0	0
ln(hhsize)	+	0	0	0	0
Proportion of dependents	---	0	--	0	0
Assets					
ln(land area owned (ha)+1)	0	--	0	0	0
ln(no. of oxen owned+1)	0	0	0	+++	0
ln(no. other cattle owned+1)	++	++	0	0	++
ln(no. small ruminants owned+1)	0	0	0	0	0
ln(value of durables owned (EB)+1)	0	0	+++	0	+++
ln(value of tools owned (EB)+1)	0	+++	0	+++	0
Own a functioning radio (yes/no)	0	0	+	0	0
Plot Characteristics					
ln(area of plot (ha)+1)	---	---	---	---	---
How plot acquired (cf. inherited)					
- PA allocation	0	0	0	0	--
- Gift	++	0	0	0	--
- Rented	0	0	+++	0	--
- Sharecropped/borrowed	0	0		0	0
Cultivated field (cf. homestead)	0	0	0	---	--
ln(walking time to plot (minutes)+1)	0	0	0	---	0
Land Investments on Plot					
- Stone terrace	0	---	--	0	0
- Soil bund	0	0	0	0	++
- Check dam	++	+	0	0	0
- Drainage ditch	0	0	+	0	0
- Live fence	0	0	--	0	0
- Stones cleared	0	0	0	0	0
- Leveled	0	0	0	0	0
- Irrigated	0	0	0	0	0
Inputs/Land Management Practices					
- ln(wage labor days/ha + 1)	0	0	0	+	0
- ln(oxen days/ha + 1)	+	+	+	+	+
- ln(seed qq/ha + 1)	+	+	+	0	+
- Improved seed used (yes/no)	0	0	0	+	+
- DAP used (yes/no)	+	+	0	0	0
- Urea used (yes/no)	0	+	0	0	0
- Chemical pesticide used (yes/no)	0	+	0	+	+

Variable	Maize	Wheat	Sorghum	Teff	Barley
- Burning used (yes/no)	-	0	-	0	0
- Manuring used (yes/no)	+	0	0	0	+
- Green manure used (yes/no)	0	0	0	0	--

0 means no statistically significant impact (at 10% level) in any regression.
+ (-) means positive (negative) coefficient and statistically significant impact in at least one of either of the two OLS regressions, the IV or RF regression.
++ (--) means positive (negative) coefficient and statistically significant impact in at least two regressions (either one of the OLS regressions, the IV or RF regressions).
+++ (---) means positive (negative) coefficient and statistically significant impact in either of the OLS regressions, and in the IV and RF regressions.

Annex 4. Types and Frequency of Main Crops Associations

Types of associations	N of plots with that association	Percent of all plots where associations are found
MAIZE-BASED ASSOCIATIONS		
Maize and wheat	50	3.5
Maize, wheat and barley	25	1.8
Maize and sorghum	171	12.1
Maize, sorghum and other grain-pulses	195	13.8
Maize and teff	60	4.2
Maize and barley	35	2.5
Maize and beans	93	6.6
	TOTAL %	44.5
WHEAT-BASED ASSOCIATIONS		
Wheat and teff	47	3.3
Wheat, teff and barley	25	1.8
Wheat and barley	391	27.7
Wheat, barley and beans	21	1.5
Wheat and beans	50	3.5
Wheat and other crops	26	1.8
	TOTAL %	39.6
TEFF-BASED ASSOCIATIONS		
Teff and barley	36	2.5
Teff and beans	36	2.5
Teff and other crops	35	2.5
	TOTAL %	7.6
BARLEY-BASED ASSOCIATIONS		
Barley and beans	51	3.6
Barley and potato	31	2.2
	TOTAL %	5.8
OTHER TYPES OF ASSOCIATIONS		
Beans and other crops	35	2.5
	TOTAL %	2.5
GRAND TOTAL	1413	100.0