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Analysis of Vulnerability to Food Insecurity in the Case of Sayint District, Ethiopia

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ABSTRACT

The objective of this study is to identify and compare the determinants of vulnerability to food insecurity among households in three different agro-ecological zones within the rural district of Sayint in South Wollo, Ethiopia. The study employed depth and severity of food insecurity measurements adopted from poverty gap measurement approaches. Findings indicates that oxen ownership, livestock ownership and access to off-farm employment opportunities are the most significant determinants of a household's vulnerability to food insecurity. All of the sampled households reported major agricultural problems such as lack of adequate land, financial constraints and lack of oxen and farm implements but highland households were found to be more vulnerable to food insecurity than lowland and midland households were. Food security analysis also indicated that 80% of highland households were found to be food insecure. The depth (60%) and severity (41%) of food insecurity were specifically found to be higher among highland households than among lowland and midland households. Generally, vulnerability and livelihood analysis suggest that food insecurity in the highland households is specifically attributed to their limited internal resources endowments and lower access to external assistance. This study will show the key areas of intervention for any development project working in reducing the vulnerability at household level.

Key words: Vulnerability, food insecurity, Head count, food insecurity gap

INTRODUCTION

Cycles of drought, famine and pestilence have always characterized Ethiopia's past (Lautze *et al*., 2003) and a significant percentage of the country's population has been affected by recurrent chronic and transitory food insecurity. In five of the past seven years, Ethiopia has had large structural deficits in the availability of food supplies as local production and commercial imports have not met needs. This has led to substantial emergency assistance to fill the gap (USAID, 2004). Food production in Ethiopia in the last three decades has not been sufficient to enable the rural population to be food secure. It was estimated that domestic food production in the late 1980s allowed for about 1620 calories per person per day, while total availability including imports was about 1770 calories per person per day. This is 16% below the minimum level of 2100 kcal per person per day, equivalent to 225 kg of grain per person per year (Negatu, 2004).

Devereux (2000) also noted that the food gap rose from 0.75 million tons in 1979/80 to 5 million tons in 1993/94, falling to 2.6 million tons in 1995/96 despite a record harvest. This clearly shows

that over the last 20 years this cycle of food insecurity has repeated itself and each time the number of people affected gets larger and the resulting amount of human suffering and disease increases. In turn, social unrest and conflict have followed despite generous amounts of emergency assistance from the international community (USAID, 2004). On a national level, the average percentage of the population in need of food assistance between 1980/81 to 2000/01 was 10% and this increased significantly to 22% by the year 2002/03. However, since vulnerability to food insecurity varies depending on agro-climatic and socio-economic factors, the proportion of people requiring food assistance exceeds this in some regions. For example, in the Amhara region, where the study area is located, the percentage of the population requiring food assistance in 2003 increased by 60% from 2002 (DPPC, 2004).

The study area, Sayint rural district is located in the Amhara National Regional State, South Wollo, the heart of what Rahmato (1986) called the 'Ethiopian famine belt'. This region was the most severely affected part of Ethiopia in the well-known famines of 1971-74 and 1983-84 and to this day, some households in the area have not fully recovered from the debilitating effects of the 1983-84 crisis (Little *et al*., 2006). As in most other drought-affected areas in Ethiopia, food security in South Wollo is precarious due to a high population density, small land holdings per household, a heavy reliance on (erratic) rain and decreasing soil fertility. South Wollo is structurally food deficient with much of the population chronically dependent on food aid (WHO, 2000).

In comparison with other parts of highlands Ethiopia, South Wollo has slightly smaller average land holdings (about 15% smaller), lower incomes and is less food secure because it depends more on the short (belg) rains than other areas (Little *et al*., 2006). The South Wollo zone is considered to be chronically food insecure because of the repeated failure of the belg rains which results in high livestock mortality and the gradual erosion of livelihoods. Within this zone, Sayint Rural District is considered to be one of the most food insecure woredas, or districts. Even in a normal year, many households are unable to rely on crop production alone (WHO, 2000). It is in this context that this study investigates dimensions of vulnerability to food insecurity among households of Sayint Rural District.

METHODOLOGY

Description of the study area: Sayint Rural District is one of 17 districts in the South Wollo zone of the Amhara region, 589 km away from Addis Ababa to the north. About 98% of the population lives in rural areas where mixed farming is the main activity. The population growth rate is about 2%. In addition, the census showed that the crude population density of the district is 104 persons per km^{-2}. Approximately 46, 37 and 17% of the population, respectively resides in the highland, midland and lowland agroclimatic zones of the district.

The district has a very diverse topography constituted of mountains, river valleys and scattered plains separated by deep-cut gorges and steep slopes. Valley relief features characterize a large percentage of the district (70%). Plains and mountain relief features constitute 17 and 13%, respectively. The altitude of the district ranges from <1500 m.a.s.l. at Meka administrative area to 4247 m.a.s.l. at the top of the Tabor mountain. In the lowest parts of the area, the climate is tropical (Kolla) while in the higher parts, a temperate (Dega) climate prevails. At the intermediate altitude, the climate is subtropical (Woyna Dega). Thus, the climatic zones of the district are classified into Dega (above 2500 m.a.s.sl) that refers to highlands, Woyna Dega (1500-2500 m.a.s.l.) that refers to the intermediate and Kolla (below 1500 m.a.s.l.) that refers to the lowlands. The Kolla agroclimatic zone constitutes 34.6% of the total area of the district while Woyna Dega and Dega agro-climatic zones constitute 22.6 and 42.8%, respectively (Sayint District Rural Development and Agriculture Office Report) (Fig. 1).

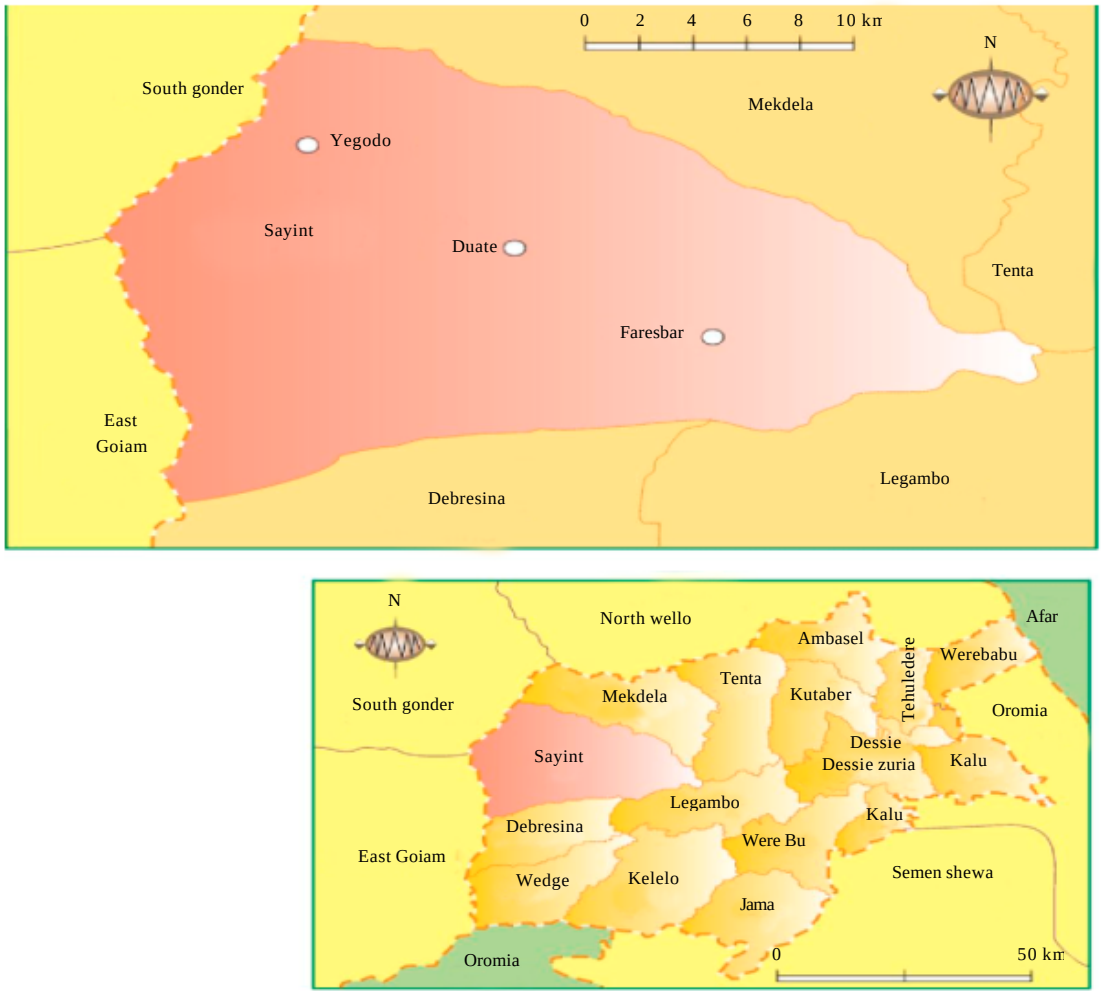

Fig. 1: Syaint district rural development and agriculture office report

Sayint Rural District has mean annual temperature of 22°C. Areas in the middle altitude range have favorable weather while the high and lowland climates are characterized by extreme weather conditions. The main rainy season is between early June and the end of September when agriculture is predominantly depends on. There is a high concentration of rainfall in July and August. The amount of rainfall generally varies with altitude and the highland portion of the area receives the highest rainfall. Small rains occur between early February and the end of April. Agriculture is the single most dominant means of livelihood in the district and 65% of the population depends on it. Despite the prevalence of agriculture, both crop cultivation and livestock rearing are the overall dominant economic activities and about 26% of the populations are engaged in business activities and in handicrafts. Two percent of the populations are daily laborers.

Sampling and data collection techniques: Selection of the specific research sites for the study (Peasant Associations or Pas) was undertaken jointly with development agents in the district Rural Development and Agriculture office; the Pas were the smallest sampling unit next to households.

The most important selection criteria were agro-climatic zone, severity of food shortage problem and accessibility. Based on the above purposive sampling criteria, three PAs were selected randomly from each agro-ecological zone. These were Feresbar, Duat and Yogodo peasant associations representing highland, midland and lowland, respectively. The total number of valid samples from the selected PAs was 89 households. The number of sample households from each PA was determined proportional to the size of each PA.

Semi-structured household questionnaire was the main data collection tool used to gather information concerning different variables pertinent to vulnerability to food and livelihood insecurity.

However, since household surveys in poor rural economies often contain large measurement errors and it is difficult to use quantitative methods to measure some dimensions of vulnerability to food insecurity, the researcher employed qualitative methods such as community group discussions and key information interviews to collect data that could not be quantitatively measured or examined.

The household questionnaire was guided by three existing documents pertinent to food security and vulnerability. These were the Amhara National Regional State District Vulnerability Profile, Ethiopia's Livelihood Integration Unit documents and the National Agricultural Household Survey. Key content areas addressed by the questionnaire included; demographic characteristics (structure of household, age, gender), health variables (household member deaths), institutional variables (market, gender, land tenure, fertilizer and other agricultural input providers), labor market (education, employment status, on/off farm labour income), production variables (livestock and crop production), other economic variables (assets, land, investment, credit), expenditure variables (food consumption, non-food consumption, durables), food variables (type and amount of food consumed, number of meals per day).

Method of data analysis

Food insecurity gap measurements: In order to capture a more detailed dimension of food security, three food insecurity measures were employed. These were Head Count Method, Food Insecurity Gap and Squared Food Insecurity Gap. Adopted from Khatri-Chhetri (2006), the measures are described below.

The Head Count Method, in this study is defined as the ratio between the number of food insecure and the total number of households under study. It provides the proportion of sample households that are food insecure. In other words, the method provides the percentage of households who consumed less than the minimum calorie requirement (2100 kcal/person/day) in the 12 months preceding the survey. Hence, it is possible to determine incidence of food insecurity in the study area.

$$IFI = \frac{FIH}{TH} \times 100 \quad (1)$$

Where:
IFI = Incidence of food insecurity
FIH = No of food insecure households
TH = Total households under study

However, the method does not provide detailed information about the food insecure households. On the other hand, Food Iinsecurity Gap (FIG) and Squared Foot Insecurity Gap (SFIG)

measurements provide the depth and severity of food insecurity among the food insecure households. The food insecurity gap is the average measurement of the gaps between the calories consumed by the food insecure households and the minimum energy requirement (2100 kcal/person/day). The equation to calculate FIG is given below:

$$FIGi = TCRi - \frac{TCCi}{TCRi} \quad (2)$$

Where:
FIGi = Food insecurity gap of ith food insecure household
TCRi = Total Calorie Requirement for ith food insecure household
TCCi = Total Calorie Consumption by ith food insecure household

Therefore, total food insecurity gap is:

$$TFIG = \Sigma TCRi - TCCi \frac{TCRi}{FIH} \quad (3)$$

Where:
TFIG = Total food insecurity gap which indicates the depth of food insecurity among the food insecure households
n = No. of food insecure households

Furthermore, the Squared Foot Insecurity Gap (SFIG) is the squared average measurement of the gaps between calories consumed by the food insecure households and the minimum energy requirement. This measurement gives more weight to the chronically food insecure households, which shows the inequality in terms of consumption distribution among the food insecure households. The equation to calculate SFIG is given below:

$$SFIG = \Sigma(FIGi) \frac{2}{FIH} \quad (4)$$

where, SFIG is squared food insecurity gap which indicates severity of food insecurity among the food insecure households.

Multi-livelihoods criterion: The other analytic tool employed was the multi-livelihoods criterion. The analysis was undertaken through the development and application of a multi-criteria ranking table indicating a household's livelihood. This involved the identification of 15 key household livelihood factors pertinent to food security and vulnerability. The factors were grouped into three categories and assigned numeric values of 0, 1 or 2 representing more fragile, fragile and less fragile livelihoods, respectively. Households achieving scores across 15 factors of between 5-9 were subsequently defined as more fragile while those whose scored values of 10-14 were fragile and 15-20 clustered as less fragile. Farmland size, oxen ownership, livestock ownership, household size and percentage share of household's expenditure on agricultural inputs are some of the major

factors identified to measure the robustness of household's livelihood. Each variable was assigned the value of 0, 1 and 2 based on a given criteria set for each variable. For example, households who owned <=0.5 hectares were considered as more fragile and those who owned between 0.5 and 2 hectares and those who owned >2 hectares were, respectively considered as 'fragile' and 'less fragile'.

In terms of oxen ownership, households who have one ox and no ox were considered as more fragile. Households who owned a pair of oxen and more than two oxen were classified as fragile and less fragile, respectively. Similarly, the share of household's expenditure on agricultural inputs was categorized into households who invest less than 25%, between 25 and 50% and >50% of their expenditure on agricultural inputs and are subsequently considered to be more fragile and less fragile. The total score of variables for each household determined the level of the household's livelihood security (more fragile, fragile and less fragile). Therefore, comparisons were possible among households and agro-ecological areas. It was also possible to analyze the relation between livelihood security and the food security status of households.

Non-parametric test statistics: Chi-square test, a non-parametric statistics were used to analyze the significance of differences between households in their livelihood security and food security status. The hypothesis to be tested was as follows: not in the result?

H = Household's food security status and livelihood profile are statistically independent i.e., there is no relationship/association between food security status and livelihood profile

H_0 = Household's food security status and livelihood profile are associated i.e., there is a relationship/association between food security status and livelihood profile

Furthermore, understanding the different forms of capital/assets as well as sources of food, income expenditure and consumption patterns including livelihood strategies are units of analysis of the study. In addition, how the vulnerability context of the study and transforming structures and processes determine the food security status of households was also the focus of the analysis.

RESULTS AND DISCUSSIONS

Food security status of households: In order to determine the food security status of households, aggregate household calorie consumptions were computed. Food security analysis is based on the minimum energy requirement i.e., 2100 kcal/person/day. Hence, households whose available per capita calories were found to be greater than their demand were regarded as food secure; on the other hand, those households who have been experiencing a calorie deficit during the last 12 months before the survey were regarded as food insecure.

The head count method of food insecurity analysis indicates that large percentage of households (75.2%) were found to be food insecure and they were not even capable of managing household food demand through a wide range of available coping strategies. In food security research, it is a conventional practice to categorize a household's food security status into chronically food insecure (less than six months food secure), potentially food insecure (more than six and less than 12 months food secure) and year round food secure (12 months and more food secure) (Lovendal and Knowles, 2006). According to Lovendal's criterion, Table 1 shows the percentage of sample households that fall under each category of food security status.

The sample households have experienced severe food insecurity problems. A large percentage (75.2%) are chronically or potentially food insecure. However, food security conditions vary across

Table 1: Food security status of sample households (in percent)

	Agro ecology			
Food security status	Highland	Lowland	Midland	All households
Chronic food insecure	52	22	21	30
Potentially food insecure	28	57	46	45
Year round food secure	20	22	32	25

agro-ecology. More than half of the highland households were found to be chronically food insecure and were not able to meet household food needs for more than 50% of the time in a year. However, the number of potentially food insecure households is higher in the lowlands and the midlands than in the highlands. There are more food secure households in the midlands (32.1%) than its counterparts (Table 1).

The highlands were also found to be more vulnerable to food insecurity due to poor internal resource endowments and access to external assistance. In order to explain the more detailed aspects of food insecurity at household level. Table 2 represents the incidence, depth and severity of food insecurity among sampled households. Incidence of food insecurity refers to the proportion of food insecure households in the study area. Table 2 indicates that there is high incidence of food insecurity in the highlands this is mainly because highland households have limited resource endowments. For example, significant determinants of food insecurity in the study area, such as oxen ownership, livestock ownership and off-farm employment opportunities are reportedly limited in the highlands.

However, incidences of food insecurity do not show how insecure the households are. Hence, the average number of calories consumed by the food insecure below the minimum energy requirement is used to explain the depth of food insecurity among food insecure households of the study area. The average depth of food insecurity is higher among highland households than among other agro ecology. This was indicated by a 60, 38 and 40% food insecurity gap, respectively among highland, lowland and midland households (Table 2). Although, incidence of food insecurity was higher in the lowlands than in the midlands; there was a relatively lower depth of food insecurity in the lowlands than in the midlands. This is mainly because significant percentages of the lowland households (55.6%) are potentially food insecure. Furthermore, the depth of food insecurity is higher among households with small farm sizes and households with limited oxen and livestock ownership than among households of any category. By squaring the food insecurity gap, more weight was given to the food insecure households that fall well below the food insecurity line (2100 kcal/person/day). The squared food insecurity gap, therefore refers to the severity of food insecurity among the food insecure households. As shown in Table 2, severity of food insecurity is higher among highland households and small farm holders, oxen and livestock holders. However, the findings indicate that higher level of incidence of food insecurity is not necessarily related to higher depth and severity of food insecurity.

Internal vulnerability to food insecurity: This dimension of vulnerability refers to defenselessness' to external shocks and stresses (Chambers, 1989). Internal vulnerability is explained by demographic and socio-economic conditions that could possibly influence either food availability or accessibility.

In this study, the specific variables contributing to internal vulnerability were household size, oxen ownership, farmland size, livestock ownership, educational status of household heads, access to off/non-farm activities and the level of investment on agricultural inputs. The average and

Table 2: Incidence depth and severity of food insecurity by agro-ecology and socio-economic characteristics

Variables	Incidenence of food insecurity	Depth of food insecurity	Severity of food insecurity
Agro ecology			
Highland	80.00	0.60	0.41
Midland	67.86	0.40	0.20
Lowland	77.78	0.38	0.18
Farm land size			
Small (<=0.5 ha)	86.67	0.59	0.39
Medium (0.5 to 2 ha)	73.85	0.42	0.23
Large (>2 ha)	66.67	0.51	0.32
Oxen ownership			
<=1 ox	92.11	0.57	0.38
2 oxen	65.96	0.34	0.15
>2 oxen	0.00	0.00	0.00
Livestock ownership			
<=3 TLU	86.11	0.55	0.35
3-6 TLU	71.79	0.36	0.17
>6 TLU	57.14	0.48	0.30
Household size			
0-2	61.54	0.40	0.21
3-5	81.63	0.49	0.30
6-10	78.57	0.46	0.25
Share of expenditure on agricultural inputs (%)			
>=25	81.67	0.47	0.27
25-50	59.09	0.36	0.21
>=50	66.67	0.67	0.52
Access to off-farm activities			
Yes	61.90	0.50	0.30
No	79.10	0.45	0.26
Access to non-farm activities			
Yes	67.86	0.41	0.19
No	78.33	0.48	0.30

percentage values of each variable determine the food security status of households. The research found that the percentage of food secure and food insecure households was 24.7 and 75.3%, respectively. Table 2 represents the average and percentage values calculated for each variable (elements of internal vulnerability to food insecurity) across a household's food security status.

As shown in the Table 3, the percentages and average results of farmland size, oxen ownership, access to off/non-farm activities, expenditure on agricultural inputs and livestock ownership were found to be higher in food secure households than that of food insecure households. On the other hand, average household sizes and the percentage of households with infertile land are higher among food insecure households than among food secure households. However, average land fragmentation and the percentage of households with illiterate heads were higher among food secure households than among food insecure households. Therefore, except in the case of land fragmentation and the educational status of household heads, the results converges with previous literature on the relationship between the major determinants of food security and a household's food security status.

Furthermore, internal vulnerability to food insecurity can also be indicated by examining the relationship between selected determinants of food insecurity and the percentage of food insecure households. Households who have limited ownership of oxen and livestock as well as no access to employment opportunities are found to be food insecure as shown by Fig. 2, which off-farm

Table 3: Household food security rates for major determinants of vulnerability to food insecurity

Variables	Food insecure	Food secure	All households
Average farm land size (ha)	1.16	1.40	1.22
Average oxen ownership	1.29	2.00	1.47
Average household size	5.79	4.86	5.67
Average livestock ownership (TLU)	3.33	4.73	3.67
Average land fragmentation	2.21	2.77	2.35
Infertile land (%)	20.90	13.64	19.10
Illiterate (%)	26.87	31.82	28.09
Primary education (%)	25.37	18.18	23.60
Engaged in off-farm activities (%)	19.70	36.36	23.86
Engaged in non-farm activities (%)	28.79	40.91	31.82
Average share of expenditure on agricultural inputs (%)	14.05	23.84	18.67

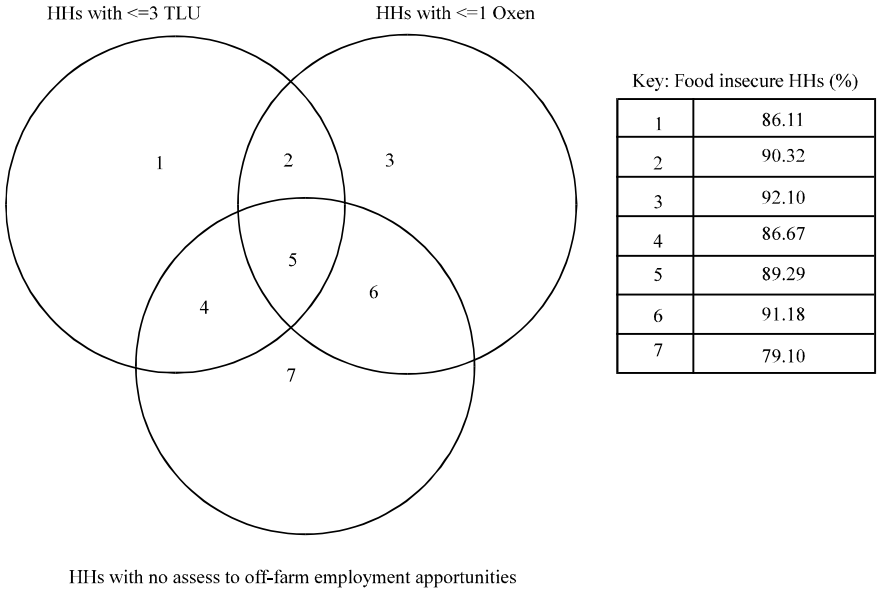

Fig. 2: Percentage of food insecure households by determinants of food insecurity

represents the percentage of food insecure households with limited oxen and livestock ownership as well as limited access to off-farm employment opportunities. There are considerable proportions of food insecure households in all sections of the diagram. For example, among those households who own less than or equal to three TLU, 86.1% of them are food insecure. Similarly, there are 92.1% of food insecure households among those who own less than or equal to one ox. This suggested that oxen and livestock ownership as well as access to off-farm employment opportunities were the three most important determinants of a household's vulnerability to food insecurity in the rural districts of Sayint.

External vulnerability to food insecurity: This dimension of vulnerability, however refers to the risks, shocks and stresses to which an individual or household is subject (Chambers, 1989). In this study, external vulnerability was examined by investigating household's perceptions of food deficit risks and major agricultural problems as well as their responses in the last five years prior to the survey.

The findings indicate that a significant percentage of the respondents (64.8%) reported that they have faced food insecurity problems in the previous ten years. Given the causes of food insecurity as sources of risk of crop production, households were asked to identify causes of food insecurity as they perceived them. Shortage of rainfall, a shortage of land and use of traditional farm implements were reported as the major causes of food insecurity. Since, vulnerability is location specific, the causes of food insecurity vary across agro-ecology. For example, in the highlands and the lowlands a shortage of rainfall was reportedly perceived as the major cause of food insecurity while the use of traditional farm implements was found to be the major cause of food insecurity in the midlands.

Households were also faced with major agricultural problems during the last 5 years as sources of risk. Lack of adequate land, financial constraints, lack of oxen and a lack of farm implements were reportedly the major agricultural problems. As the result of these problems, about 39.2% of households reported that they have been exposed to food shortage, 32% to poverty and 15.2% to epidemics.

In addition, 31.8 and 35.2% of households, respectively reported famine and poverty to be severe problems faced in the last five years. However, responses concerning severity and frequency of problems vary across agro-ecology. For example, among those households who reported famine as a frequently-occurring problem about 50% were in the highlands, 34.3% in the lowlands and 15.6% in the midlands.

CONCLUSIONS

The objective of this study was to identify and compare the determinants of vulnerability to food insecurity among households of different agro-ecologies. The key determinants of a household's vulnerability to food insecurity include farm size, land fertility, household size, level of investment on agricultural inputs, oxen and livestock ownership and access to off/non-farm employment opportunities. However, the relative significance of determinants varies across agro-ecology. For example, in the highlands, oxen ownership, access to off-farm employment opportunities and level of education of household heads are found to be key determinants. In the lowlands, oxen ownership and level of investment on agricultural inputs are the two significant factors. There is no one significant factor that will determine a household's vulnerability to food insecurity in the midlands but land fertility, livestock ownership and level of investment on agricultural inputs have relatively determined a household's vulnerability to food insecurity. Given major agricultural problems such as lack of adequate land, financial constraints, a lack of oxen and a lack of farm implements, highland households are found to be the most vulnerable to food insecurity. This is mainly because they have limited internal resource endowments and external assistance.

Food security analysis based on the internationally accepted minimum calorie consumption at household level indicates that majority of the households (75.3%) are food insecure. Incidence of food insecurity varies across agro-ecology and large percentages of highland households (80%) are found to be food insecure. Similarly, there are more chronically food insecure households (52%), who consume less than 50% of total calorie requirements in the highlands than in the lowlands (22.2%) and in the midlands (21.4%).

Based on total food insecurity gap and squared food insecurity gap measurements, both depth and severity of food insecurity are highest among highland households the severity is twice as much as it is among lowland and midland households. Furthermore, average incidence and the depth and severity of food insecurity are higher among households with small farm sizes and limited oxen and livestock ownership than any other category. In

addition, the findings indicate that a higher level of incidence of food insecurity is not necessarily related to a higher depth and severity of food insecurity.

Therefore based on the findings of this study the following recommendations are suggested to food security and rural development programs undertaken in the study area.

Since, almost all of the households depend on agricultural production for household food consumption, crop diversification, the selection of an appropriate variety of crops (drought and disease resistant, early maturing and high yielding) and the improvement of methods of cultivation should be primary objectives of rural development programmes.

Promoting income diversification and creating income-generating opportunities should be critical areas of concern to mitigate household's vulnerability to food insecurity.

Promoting irrigation in the study area is critical to reduce the risk of unviable, low return, rain-fed agriculture. There are rivers and small streams in the study area suitable for irrigation.

Improving agricultural extension and social services is also critical areas to mitigate household's vulnerability to food insecurity in the study area. Appropriate extension services have to be expanded and farmers in the study area should be introduced to improved seeds and farm implements.

Credit services and government support are necessary conditions in order to improve farming practices, i.e., the use of improved seeds, fertilizers, pesticides and farm implements.

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