ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

FACULTY OF BUSINESS AND ECONOMICS

ANALYSIS OF RISK AND SUPPLY RESPONSE OF AGRICULTURE: EMPIRICAL INVESTIGATIONS FROM THE ETHIOPIAN COFFEE GROWING ZONES

BY

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Abbreviations

1. EEPA = Ethiopia Export Promotion Agency
2. EPRDF = Ethiopian People's Revolutionary Democratic Front
3. ETPSA = Ethiopian Technology Policy Studies Association
4. FLO = Fair Trade Labeling Organization
5. FE = Fixed Effect
6. GIC = General Insurance Corporation of India
7. GOE = Government of Ethiopia
8. HAPCO = HIV/AIDS Protection and Control Office
9. HH = Household
10. ICO = International Coffee Organization
11. Kg = Kilogram
12. lb = Pound
13. MCTD = Ministry of Coffee and Tea Development
14. MoARD = Ministry of Agriculture and Rural Development
15. NBE = National Bank of Ethiopia
16. OLS = Ordinary Least Squares
17. RE = Random Effect
18. SAP = Structural Adjustment Program
19. SD = Standard Deviation
20. SNNPR = Southern Nations Nationalities and Peoples Region
21. UNICEF = United Nations Children's Fund

22.WB = World Bank

Abstract

A study was conducted to examine the major shocks and their impact on coffee production and the livelihood of smallholder coffee farmers in five major coffee growing zones of Ethiopia, namely, Sidamo, Jimma, Illubabor, Wolayta and West Hararghe.

After pooling the available data set using the error component model, the pooled OLS and fixed effects regression methods were used to analyze the effects of shocks on coffee production and supply response variation across the study areas.

It was found that a combination of shocks including drought, pests and coffee diseases, drastic fall in world coffee price and health problems have serious effects on coffee yield and household income. Households living in different zones of the country have different supply responses because of the socio-economic and agro-ecological differences.

In the face of the severe effects of shocks, farmers have adopted a range of risk management strategies such as intercropping, depleting assets, borrowing, membership to a social support system and production/marketing unions. However, under the prevailing production technology and farming systems, the strategies employed by farmers are not adequate enough to cope with the effects of the recurring shocks.

Policy implication of the study is that one-size-fits-all policy packages and blanket recommendations cannot solve the problems of coffee farmers. Therefore, under the current dynamic market scenario, the success of the Ethiopian coffee sub-sector highly

depends on targeted support to reduce the impacts of shocks and to build the capacity of indigenous institutions. Interventions need to be disaggregated by agro-ecological zones and socio-economic settings.

CHAPTER I

INTRODUCTION

1.1. BACKGROUND AND PROBLEM STATEMENT

Agriculture has been and remains to be the backbone of Ethiopia's economy. According to the report of the National Bank of Ethiopia (NBE, 2005), agriculture employs about 85% of the total population and 90% of the total export earnings. Hence, the performance of the agricultural sector largely determines the performance of the entire economy of the country.

Coffee production is one of the major agricultural activities and accounts for a large share of the GDP. The coffee sub sector employs over 25 million Ethiopians, generates around 60% of export earnings and contributes a lot to the government revenue (Ibid).

There are two main coffee varieties, namely, arabicas and robustas. Arabica has mild taste, and is a fragile plant best grown in warm areas or in highlands of tropical zones (Milford 2004). Ethiopia is the centre of origin and diversity for coffee arabica, which is the leading commercial species accounting for the 90% of the total coffee production in the world. Arabicas are considered to be of higher quality and sold to specialty markets at slightly higher prices than robustas (Bacon, 2004).

Although coffee is said to be the green gold for Ethiopia, the productivity of the sub sector has remained so low and its contribution to the national economy and household income has rather been stagnant. A survey conducted by the Ministry of Agriculture and Rural Development (MoARD) has shown that the average labour productivity in the coffee sub sector is 2.6 kg per farmer per year (MoARD, 1995). Another study has also shown that the average national coffee yield is 574 kg/ha, which is the lowest even in African standards. For instance, the Ethiopian average coffee yield is half of the yield in Kenya (Tessema, 2001). Both price and non-price shocks are believed to be among the major factors that explain the low productivity of the coffee sub sector.

Ghatak and Seale (2001) argue that the prevalence of shocks affect the responsiveness of farmers to various incentives. Even if investment doors are open, shocks challenge the farmers' living conditions and limit their ability to develop and expand their capacity, because they represent an obstacle to access to different growth opportunities. From the theory of risk-averse peasant (Ellis 1993), it is understood that if the sources of risk are removed, peasant agriculture could develop.

There is, however, limited information on the impact of shocks on the supply response of the farmers in the coffee sub sector. There is a wide gap between the economic theory of risk behavior and supply response studies. Further, the previous supply response studies focused only on a specific region and do not show regional variations in the supply response (Dambala, 2002; Asmerom, 1999; Yoseph, 1994; Abdureaman, 1995; and Kidist, 2000). But in reality, different farm households located in different regions face different types of shocks, which could result in dissimilar supply responses. That means supply response variation is linked to the fact that the coffee growers are rooted in varying socio-economic and bio-physical settings with varying nature of shocks. Hence, the concomitant supply response is believed to be variable for each region.

Against this background, the present study is designed to investigate the nature of shocks experienced by farmers in different coffee growing regions of the country and to assess the impacts of the perceived shocks on the supply response of the coffee sub sector. The study shows the profile of major shocks that Ethiopian coffee farmers are facing, the impact of the shocks on yield and livelihood of smallholders, various coping mechanisms adopted by farmers and the supply response variation across regions. Identifying the shock episodes faced by the coffee farmers across regions and understanding the impact of these shocks on the farmers' supply response has a significant role in agricultural policy analysis to design feasible extension strategies for Ethiopia's longstanding export earner, coffee.

1.2 OBJECTIVES AND KEY RESEARCH QUESTIONS

The overall objective of this study is to examine the impact of shocks on the supply response of coffee in five typical coffee growing zones of rural Ethiopia. The following are the specific objectives of the study:

- To identify the major types of shocks (risks) that Ethiopian smallholder coffee farmers face;
- To understand the impact of shocks on the livelihood of coffee farmers and on the coffee supply response;
- To know how farmers respond or cope with various shock episodes;
- To examine the supply response variations across regions; and
- To draw policy implications for the action of the concerned pro-poor actors.

Key research questions

The study is set out to try and answer the following research questions:

- What are the major shocks experienced by the smallholder coffee farmers residing in the study areas and what coping mechanisms are adopted?
- What are the effects of shocks on the supply response of the coffee sub sector?
- Is there any variation in supply response across households in different coffee growing zones?
- What policy implications can be drawn for the intervention of both Government and non-government organizations?

1.3. RESEARCH HYPOTHESES

From the objectives and research questions, the following hypotheses are formulated:

- Various types of shocks experienced by smallholder farmers have an adverse effect on the supply response of coffee;
- The different coffee growing zones of Ethiopia have different supply response depending on the prevailing ecological and economic conditions of that particular zone.

1.4. LIMITATIONS OF THE STUDY

The long run supply response studies of perennial crops usually require a time series data of many years to understand the response trend over time. The current study lacks such time series data and uses a data of few years (1990 – 1997 E.C.). Consequently the long run supply response analysis may not show the exact picture. Thus emphasis is given to the short run analysis or the supply response variation across the study sites (the within effect analysis).

The other limitation of the study is that the sample size has decreased from the original amount because some outliers and missing records were deleted from the data set to make the estimates precise. Therefore, values in some tables may not exactly match with that of the full data.

1.5. ORGANIZATION OF THE PAPER

After identifying the problem and setting the objectives of the study in the introductory chapter, the paper begins with the literature review on shocks and supply response of perennial crops in the second chapter. In chapter three, source of the data and method of analysis will be discussed. Chapter four dwells on major types of shocks, the impacts of the shocks and indigenous risk management strategies adopted by Ethiopian coffee farmers. Empirical results of the supply response model, diagnostic tests and discussion of the results are also presented in this chapter. The final chapter is devouted to conclusions and policy implications for the action of concerned stakeholders in the coffee sub-sector towards addressing the prevailing shocks with feasible strategies.

CHAPTER II

LITERATURE REVIEW

2.1.Theoretical Literature

2.1.1. The Concept of Shocks/Risk

Human life is always subject to shocks. Some shocks such as diseases, accident, or death directly affect peoples' well being, while others such as drought, flood, pests, loss of assets, conflicts, and disability affect their ability to support and feed themselves.

The Cambridge International Dictionary of English defines Shock as an unpleasant event that occurs suddenly. Risk on the other hand, is defined as a probability of occurrence of an event, which influences the outcome of a decision-making process. Here, probability means the expected frequency of occurrence of an event or a set of events, and is always expressed out of one. Shock and risk are related in the sense that shock is the manifestation of risk.

Shock or risk can be categorized as high vis-à-vis low frequency, auto correlated vis-à-vis non-auto correlated, collective vis-à-vis idiosyncratic, and utility risk vis-à-vis income risk (Morduch, 1995; and Fafchamps, 1999). According to Fafchamps (1999), it is possible to estimate individual risk factors as a Poisson process in which the number of occurrences $Z_j(t)$ of a given shock j over a time interval t as:

$$\text{Prob}[Z_j(t)=Z] = \frac{e^{-v_j t} v_j^z t^z}{z!}$$

Where V_j denotes the mean rate of occurrence of shock j.

Based on this formulation, one can classify a given risk as a high frequency risk, if it has a high V_j and as a low frequency risk if it has a low V_j. Other things being equal, high frequency risks are more dangerous than low frequency risks. But here, one should also consider the intensity of the risk. For example, a high frequency risk factor that only has a minor incidence on someone's welfare is less dangerous than a low frequency risk that has serious consequences.

In the above theoretical model of risk, it is assumed that shocks are independently distributed over time. In reality, however, this is not always the case. Some shocks are auto correlated. For example, if a given rural household faces a risk of crop failure then this may lead to malnutrition of the household, which in turn, raises vulnerability to other risk factors (e.g. disease). Shocks also vary across individuals and households. The literature calls such risk factors as idiosyncratic risks. Examples include illness, unemployment, death, accident etc. Collective (covariate) risk factors, on the other hand, are those risks that affect a group as a whole such as drought, epidemics and war.

A given risk factor can be classified as utility risk if it affects the individual welfare or utility directly. If the risk affects only the income or wealth of a person, then it is called income risk. But in practice, the boundary between the two is not very clear. For example, if a crop of a given rural household fails then this directly affects the income of the household and it can be considered as an income risk. But the crop failure may also have an indirect effect on self-esteem and quality of life, which would be classified as utility risk. Thus it is a matter of degree. However, this classification is important in analyzing risk coping strategies. For instance, the economic impact of diseases should not be evaluated in terms of income loss alone, but also in terms of pain and suffering (Ibid).

Risk is pervasive in rural areas where the majority of households are poor. Epidemic diseases kill millions of the rural poor. Insects, birds, monkeys, rats, and other wild lives destroy their crops in the field and in storage. The rudimentary technology of farming makes the rural poor prone for natural hazards, their business is vulnerable to various shocks, and the range of risk factors that the rural poor are facing is so overwhelming.

There is also a category of risk that is termed as an "opportunistic risk". Such risks frequently occur in business activities when opportunists falsely claim that they are unable to comply with their contractual obligations due to circumstances beyond their control (Udry, 1994). Examples include unfulfilled orders, labour absenteeism, broken contracts, and low quality of services. In some cases, markets totally fail or become inexistent due to the fear of breach of contracts. This is common in rural areas where the enforcement of property rights is not so tight.

- **Sources of Risk /Shock**

The literature on risk identifies four major sources of risk or shock (Ellis, 1993; Fafchamps, 1999; and Udry, 1994). These are:

- Natural hazards, which have unpredictable impact on output. They are also called yield risk. Climate change, pests, diseases, and other natural calamities can be mentioned as examples of such risk factors.
- Price risk is another common type of risk, which occurs in agriculture because there is a time lag between the decision to plant a crop and to harvest it. It is clear that market prices at the point of sale are unknown by the time when production decisions are made. This type of risk is more serious in poor economies where there is a serious information asymmetry and market imperfection. Price risk is more severe for perennial crops such as coffee with a long time lag between planting and harvesting.

- Social risk is another source of insecurity, which is caused by differences in control over resources. For example, if there is unequal ownership of land in rural communities, this can create an uncertainty concerning access to and ownership of land by the poor households.

- Another source of risk to peasant families but usually over-looked in economic literature is the risk caused by state actions and wars. Unpredictable policy changes can be taken as an example of such risk factors. This is a common source of risk in least developed countries such as Africa where coups and guerilla wars occur frequently.

- **Impacts of Risk/Shocks**

It is obvious that risk is an exogenous event to any economic agent. It occurs at its own time and affects the life of the poor who have a limited capacity to manage it well. Risk can affect many life dimensions of the poor such as health, nutrition, education, and income. Risk can cause both ex-ante and ex-post losses in terms of growth since it may lead to poverty persistence and traps. The ex-ante impact of risk can be expressed in terms of changes in the behaviour of an economic agent (Dercon, 2005). For instance, if a farmer knows that coffee production is profitable but it is risky, then he may choose to plant other less risky crops at the expense of the more profitable opportunity. This means that he chooses poverty due to risk in case he decides to grow subsistence crop instead of a high value cash crop. Loss or reduction of income is the other major impact of the shocks on farmers. It leads to deprivation of basic human rights such as education, health, access to food, sanitation, clean water and increased livelihood insecurity. Due to shocks many households sell their assets or resort to borrow from local moneylenders at very high interest rates.

- **Potential Risk Management Strategies**

Through out his lifetime, human being tries to cope with risk factors to minimize the bad consequences of risk and to increase the likelihood of his survival. There are two options to mange risk: to reduce the risk itself or to cope with the risk (Brown and Churchill, 1999). There are so many methods of reducing risk. Few of them are mentioned here under (Dercon, 2000; Fafchamps, 1999; Morduch, 1995; Jacoby and Skoufias, 1997):

- **Selecting and modifying the environment:** If an environment is risky, then one way to reduce that risk is to leave that environment. If malaria risk is high in lowlands then people will migrate to highlands. During the severe famine in Ethiopia in 1984, one major option to reduce the risk was resettlement. The Ethiopian Government resettled about one million people from the drought prone northern highlands to wetter southern lowlands. When people settle in a forest area, they remove the forest in their immediate surroundings to reduce exposure to disease carrying insects and to depredations from wildlife. This is one way of modifying the environment.

- **Specialization:** If an environment is risky, people focus on specific, risk-robust production technique to reduce risk. For example, millet is perfectly adapted to the peculiar conditions of the Sahel because this crop can grow in poor sandy soils under short rainy season and erratic rainfall. Thus people in the Sahel specialize in millet production (Fafchamps, 1999; Eddy, 1979).

- **Diversification:** Rural people minimize their exposure to risk by diversifying their portfolio of income generating activities. For example, farmers often plant different crops, or several varieties of the same crop to obtain a more stable output. Inter cropping, that is, planting several crops in the same field at the same time is also one way of reducing risk. Farmers are rational and they usually know from experience, in which situations to specialize and in which other situations to diversify their production.

- **Self-sufficiency:** Rural households always worry about being able to feed themselves. Food security is their major issue especially when food markets are absent or not reliable. Thus they try their best to grow their own food and reduce the risk of food insecurity (Singh et.al., 1986).

- **Flexibility:** Is another way of reducing exposure to risk. Here, flexibility means remaining flexible and deal with the shocks as they unfold. Replanting is a good example of flexibility. In the semi-arid tropics, rainfall is erratic. Rains begin during rainy seasons but stop abruptly and restart several weeks later. In such circumstances, seeds planted after the early rains fail to grow. Then farmers replant those varieties which can be planted over an extended period of time and are not highly sensitive to the length of the day (Matlon and Fafchamps, 1989).

The above risk reduction methods can be termed as Ex-ante strategies because they are measures taken before the risk actually occurs. Such strategies reduce the magnitude of the shocks themselves and hence decrease the exposure to risk.

There are also ex-post methods, which are used by rural households to reduce the impact of the loss experienced by a household after the risk occurs. They are known as risk coping strategies (Brown and Churchill, 1999; and Tilahun, 1995). Ex-post strategies are required because Ex-ante strategies alone cannot eliminate risk altogether. A given household may migrate to a less risky region, but still individuals in that household are subject to disease or death. Thus, it is inevitable to deal with the situation after the shock has been realized.

Ex-post strategies can be undertaken either at individual level (self-insurance) or at community level (through risk-sharing arrangements). Few of self insurance strategies are discussed below (Brown and Churchill, 1999):

- **Liquidating productive assets:** if a household faces a serious income shock, then it sells its livestock or other fixed assets to buy food, to take its children to the clinic, or to pay the school fee for the children. This is a method to buy time in the hope that things will improve in the future and the household will purchase its assets back.

- **Borrowing:** when households become unable to absorb shocks by liquidating assets, the next option to manage the situation is to borrow. Details about borrowing and the constraints to borrowing are found in the works of (Fafchamps, 1999; and Eswaran and Kotwal, 1989).

- **Reducing Consumption:** Poor rural households usually prefer to reduce their consumption rather than liquidating their productive assets.

2.1.2. The Theory of Supply Response of Perennial Crops

In economics two theories play a crucial role: These are the theory of demand and the theory of supply. The theory of demand basically investigates consumer behaviour. It explains the level of demand for commodities an individual consumes given the structure of relative prices faced, real income, and a set of individual characteristics such as age, education, and location. Knowledge of consumer behaviour is important to answer a wide range of development policy questions and to design appropriate intervention strategies, which improve the welfare of the society.

Theory of supply on the other hand, focuses on the supply side of the economy. It investigates how producers respond to changes in output and input prices, technology, access to markets, credit, land, and shock episodes. Studying about the supply response of products is central to policy decisions in the sense that it helps to understand the impact of alternative policy packages or exogenous shocks on the behaviour of producers. Analysis of supply response shows how output supply and input demand respond to both price and non-price variations (shocks). According to de Janvry et. al., (1995), the analysis of production response is an essential component of models that seek to explain market prices, wages and employment, external trade, and government fiscal revenues.

The purpose of studying supply response is to estimate the elasticity of supply of a crop to various shocks or incentives. There are two major types of elasticity of supply for which policy makers need information: those of individual crops and that of the sector aggregate.

The elasticity of supply is higher for individual crops than for the sector aggregate. This is because variable factors of production can be reallocated easily across crops. Whereas aggregate response requires expansion of area or other fixed factors, technological change, or shifting from more fixed-factor extensive to a more fixed-factor intensive activities, all of which are slower and more difficult to achieve than variable factor reallocation (Ibid).

In the study of the supply response of perennial crops, it is possible to examine both the short-run and the long-run supply responses. Short-run response refers to changes in supply from a fixed stock of capital or from the existing number of trees. In the short-run supply response analysis, the issues to focus on include: the rate of annual production or harvest; the impact of technology adoption on the production of the crop; the adverse effect of shocks on crop production and yield; and the use of other variable inputs and regional variations in output and yield of the crop (French and Mathews, 1971).

The long-run response on the other hand, refers to change in capacity. It depends on the long term profitability of the investment on the crop. Once the trees are planted, it takes years to see the output of a perennial crop and to decide either to cut the tree or to let it continue to grow. It also takes time for a perennial crop to respond to a change in an exogenous variable. This implies that, in modeling the supply response of perennial crops, it is necessary to incorporate shock episodes and consider lag effects. It involves the decision for new tree planting, for tree removal, for replanting, and for an increase in area covered by that crop. Many scholars agree that studying the long run supply response of perennial crops is very complex and tricky exercise (Wickens and Greenfield, 1973; Asmerom, 1999; and French et.al., 1985).

2.2. Empirical Studies on the Supply Response of Perennial Crops

Numerous studies have been conducted across the globe to estimate the elasticities of supply of perennial crops. It is beyond the scope of this study to list and review them all. However, it is worth mentioning some of the major supply response studies conducted in the past to learn from their method of analysis, and the relevance of the results to policy formulation.

Wickens and Greenfield (1973) studied the supply response of coffee in Brazil by constructing a structural model suitable for perennial crops. They classified coffee production decision into two parts: a long term decision of potential production and a short term decision of harvesting some proportion of the potential production. They specified structural equations, derived a reduced form supply function and estimated the supply response coefficients. They used time series data for the period 1932-1969 and estimated the area under coffee in Brazil using OLS estimates. They also estimated the short term annual production (harvesting) function by taking the previous period quantity and price as explanatory variables to capture lag effects. One major finding of their study is that Nerlovian model of supply response for annual crops fails to capture the structure of perennial crop supply. The main objection to using the Narlovian approach to explain the supply response of perennial crops is that it is based on a set of ad hoc behavioral relationships in which the distinction between the long term investment and the short term harvesting decision is suppressed. This makes the derived supply function to fail to capture the effect of previous period investment on the current supply response. Klein and Behrman (1970) also have explained the area in Brazil under coffee as a function of the price of coffee and lagged area.

French and Bressler (1962) on the other hand, explained the proportionate increase in the area under lemon tree (a perennial crop), as a linear function of expected profits and the proportion of the total area covered by lemons.

French et. al., (1985) estimated the supply response of the Californian Cling Peach (a perennial crop) using a time-series data for the period 1956 to 1980. They estimated equations for new tree planting, annual production, yield of the trees and removal decision of old trees. The interesting feature of their study is that they included risk as an explanatory variable in the supply response model. They used a simple OLS estimation technique, made various tests on its validity and accepted OLS as appropriate estimation procedure. The signs of the coefficients are consistent with theoretical expectations and statistically significant. The result of the yield equation shows that yield varies as age increases and it follows an inverted U-shape. This study is more interesting in that it takes care of the unique features of perennial crops such as long gestation period and yield variation as tree age increases.

Another supply response study worth mentioning here is the one conducted by French and Matthews, (1971) on American Asparagus- a perennial vegetable crop with a productive life of ten to fifteen years. They used a pooled cross-sectional data collected from three American regions and estimated the annual production, new planting and yield functions. They have modified their basic model to make use of only the available information. The estimation results were consistent with their behavioural hypothesis and indicate that it is possible to develop meaningful supply response relationships for perennial crops in circumstances where the data at hand are incomplete.

Supply response studies conducted in the coffee sub sector are few and limited in Ethiopia. Asmerom (1999) studied the response of Ethiopian coffee farmers to changes in the domestic price of coffee. He used a pooled cross-sectional and time-series data where the former was collected by administering a farm-level questionnaire while the later was found from secondary sources, mainly from the Ministry of Coffee and Tea development (MCTD) of Ethiopia. The result of his analysis exposed that there is a positive response to price incentives both in the short-run and in the long run. In the short-run farmers were able to increase yield through increased use of labour and fertilizer on existing stock of coffee trees. In the long run, there was an increase in the uprooting of old trees and replacing them by new ones, as well as the use of extra acreage at the expense of other perennials and annuals.

However, he strongly argues that estimating the long-run supply response is intricate and very difficult task. This is because, issues in the economic analysis of long-run response of a perennial crop needs a knowledge about expectation formation, present value calculation, the trade-off between present and future income, and the trade-off between asset value and change in income. The concept of expectation formation involves consideration of several variables such as uncertainties which farmers face about prices and exchange rates, yield, wages, inflation, and government polices etc.

Asmerom (1999) collected data only from Sidamo zone (one of the coffee growing zones of Ethiopia) using a random sampling technique. This can make the data set non-representative because there is a variation in the supply response due to differences in socio-economic and bio-physical characteristics across the major coffee growing regions of the country.

Dambala (2002), on the other hand, predicted the impact of policy changes on coffee supply under imperfect rural markets using a household survey from Southern Ethiopia. He tried to identify the determinants of the probability and size of supply response in terms of the change in land allocation to coffee production in response to the Structural Adjustment Program (SAP)-induced price incentives.

His estimation result reveals that the size of land holding strongly influences the decision to undertake area change because it captures wealth effect on the supply response and prompts the household to respond positively to price incentives. Participation in credit market (borrowing) had also a positive correlation with area response because credit can ease the capital constraint to purchase coffee seedlings and hire labour required to increase coffee production. Among other household specific explanatory variables he used, level of education of the household head, off-farm income, and village dummies are the major ones. Some of these variables were in-line with the priori-expectation while others were not. This study demonstrated that rural factor and product markets play a crucial role in the supply response of coffee and the response is not homogeneous across households due to household-specific socio-economic variables.

Effect of risk is not included in his analysis and the study is limited only in one district, which may not represent the whole coffee growing regions of the country and hence the results must be interpreted with caution. He took the difference in area allocated to coffee before and after the Structural Adjustment Program (SAP), given a zero value to all zero and negative responses, a value of one to all positive responses and then used a discrete choice model to estimate the supply response of coffee to SAP. From the theoretical point of view, the main weakness of this approach is that it does not show the individual difference in supply response among households because all positive responses are given a single value of 'one' and all negative and zero responses are given a value of 'zero'. It is not clear by how much each household responds to the price incentive.

Abdurahman (1995), on his part, investigated the determinants of the elasticity of coffee supply using both cross-sectional and time-series data from Hararghe highlands. To understand the coffee farming system, its characteristics and constraints facing the farmers, he collected a cross-sectional data from 60 households residing in two peasant associations of the Hararghe zone. His study found a short run price elasticity coefficient of 0.6, which is in line with the argument that individual crop price elasticity is larger because farmers can shift their variable inputs between different crops more easily. On the other hand, he also found that availability of consumer goods has a positive impact on the supply of coffee. In his estimation, he found that the signs of all the parameters to be consistent with his priori expectations except the coefficients for the coffee in the parallel market. The study suggested that increased relative producer price of coffee alone cannot be enough to induce a significant positive response by coffee farmers because they face various non-price constraints in coffee production. Thus the increase in price should be accompanied by various structural reforms to remove these constraints and to encourage coffee production and supply. The data was collected only from one zone and it does not show the supply response variation across zones. In his analysis, he did not take into account the adverse effects of shocks and the unique features of perennial crops. He just used a simple OLS technique. Thus the estimation results may not be reliable.

2.3. Alternative Models Used in Supply Response Studies of Perennial Crops

Before choosing an appropriate model to estimate the supply response of Ethiopian coffee sub sector, it is important to review relevant modeling techniques used in previous empirical works. In agricultural supply response studies, the work of Nerlove (1958) has been used widely. Originally, Nerlove's model was developed and applied for field crops in which lags are absent. As mentioned earlier, perennial crops have unique characteristics such as: long gestation period between planting and harvesting, extended period of output beyond a single year, and the gradual deterioration of the yield of the trees as they get older. The harvesting decision and the decision to supply final markets, especially when they are foreign markets, introduce further lags. Due to these unique features of perennial crops, a supply response study of such crops should take into account the farmers' decision to plant the trees, to harvest some proportion of the trees, to replace some of them by other trees, and the lag between input and output. Thus, the direct use of Nerlovian approach is not justified for such tree crops where lags are common (French et.al., 1985; and Wickens and Greenfield, 1973).

Instead, there are other alternative methods to estimate the supply response of perennial crops. If price data can be found, it is possible to compute the annual production and yield of the crop using profit obtained from the sales of the crop and alternative uses of the land or the opportunity cost of resource used in the perennial crop production. Following the trend of French and Matthews (1971), the annual production from existing trees can be estimated as follows:

$$Q_t = Q^e_{t-1} + b_{11} (\Pi^e_t - \Pi^*_t) + b_{12} (\Pi^e_{At} - \Pi^*_{At}) + U_{1t}$$

Where Q_t = Amount of annual production from the existing trees.

$Q^e_{t-1} = Y^e_{t-1} A_{t-1}$ = expected average production from an acreage (A) in period t-1

Y^e_{t-1} = Expected yield of the crop in period t-1

A_{t-1} = Area covered by the crop in period t-1

Π^*_t and Π^*_{At} reflect the long term profitability of the crop and the profitability of alternative land uses respectively.

U_{1t} is the disturbance term with the usual OLS properties.

The average yield (Y_t) function for a tree crop on the other hand, can be specified as:

$$Y_t = a_{it} A_{it} + b.T + V_t$$

Where $A_{it} =$ the area covered by trees of age i in year t. This variable is basically used to capture how yield varies with the age of the crop.

T= Time or trend variable to capture the effects of technological changes over time.

V_t= Disturbance term which is used to reflect the effects shocks on the supply response

If the trees are classified into different age groups, then the above yield equation can further be modified as:

$$Y_t = a_{10} + a_{11}A_{11} + a_{12} A_{21} + a_{13} A_{31} + a_{14}T + V_{4t}$$

Where A_{ij} is area covered by a tree of age i and a_{ij} is age of the tree.

This equation can be used to estimate yield relationship when a time series data pertaining to age distribution of the trees can be found.

If price data is readily available, then it is also possible to estimate the supply response of a perennial crop using the strategy followed by Wickens and Greenfield (1973) in their study on the supply response of coffee. According to this technique, the proportion of potential production that is harvested every year depends on the recent price behaviour.

It is given as: $\frac{Q_t}{Q_t^p} = \alpha + \sum_{i=0}^{m} \beta_i P_{t-i}$

Where Q_t = Actual annual production in period t

Q_t^p = Potential production in period t

P_{t-i} = Recent price behaviour, i = 1, 2

If price data of output and cost of inputs to calculate the profitability of a given perennial crop can not be found easily, an alternative modeling technique of French at.al.,(1985) can be used. Using this method one can estimate the supply response of a perennial crop from a data set on area covered by the crop, income obtained from alternative sources and number of the existing stock of trees. French et.al., (1985) have used this technique to estimate the supply response of Cling Peaches. In the absence of price data, there is also another method to estimate the annual production of a perennial crop by observing the previous period output behaviour. For example, Rourke (1970) has specified and estimated a supply response model for coffee production in Brazil using the previous period output as an explanatory variable and he found the following result.

$$\Delta Q_t = 1000 - 0.745 \Delta Q_{t-1}$$

Where: ΔQ_t and ΔQ_{t-1} are the changes in output in period t and t-1 respectively.

Another way of estimating supply response of perennial crops is to use discrete choice models (Damballa, 2002). In this strategy, it is possible to take the difference in quantity produced or area covered by a perennial crop before and after a shock. Positive changes are set to one while zero and negative changes are set to zero. Then estimation using either the probit or logit model follows. The major weakness of such methods is that it does not show the real difference in response among households or zones. It gives a value of one for all positive responses and a value of zero for all negative and non responses.

CHAPTER III

DATA SOURCE AND METHOD OF ANALYSIS

3.1. Data Source

The data used for this study comes from a survey conducted by the Ethiopian Technology Policy Studies Association (ETPSA) in 2005. A formal questionnaire instrument was administered with 1033 households from five major coffee growing zones (Sidamo, Jimma, Illubabor, Wolayta and West Hararghe). In these zones, nine coffee growing woredas were covered. The number of sample households in each of the study sites varied depending on the total coffee growing population in the respective areas. Thus in order to get a weighted mean, a proportional sampling procedure was used (Table 3.1).

Table 3.1: Number of Households Selected from each Zone

Zone	Number of households interviewed	Percentage of the total sample
Sidamo	238	23.0
Jimma	241	23.3
Illubabor	232	22.5
Wolayta	132	12.8
W/Harrarge	190	18.4
Total sample size	1033	100.0

Household heads were asked about coffee production and yield; types and sources of shocks which they face; impact of shocks on household income and consumption; and coping mechanisms employed. The household survey was undertaken from April -June 2005.

3.2. Description of the Study Sites

In Ethiopia, coffee production is undertaken in four major systems, namely, forest coffee, semi-forest coffee, garden coffee and plantation coffee accounting for 10%, 35%, 50%, and 5% of the total production, respectively (Celia, et.al.,2003). In the forest coffee production system, subsistence farmers directly harvest coffee from wild populations of the understorey coffee plants growing in Afromontane rain forests of west and southwestern Ethiopian regions such as Illubabor and Jimma (Ibid).

The garden coffee is grown around the homestead either in pure stands or intercropped with other staple crops such as enset and annual crops like maize. The garden coffee plantation is common in densely populated areas such as Wolayta and West Hararghe. In these areas subsistence farmers plant 1000-2000 coffee trees around the homestead (Eyasu, 2002). Currently, about 95% of the total coffee production is from the smallholder farms, which are rain fed. Most households in the study areas have less than one hectare of land covered by coffee trees. The management practices (e.g., pruning/pollarding, field hygiene, etc) are backward with limited use of modern technologies such as improved varieties and fertilizers.

The bulk of coffee production in Ethiopia comes from western, south-western and eastern agro-ecological regions. Typical coffee growing zones in these regions are Sidamo, Jimma, Illubabor, Wolayta and West Hararghe (Asmerom, 1999).

3.3. Method of Analysis

It is possible to study the supply response of individual crops using models that take into account both macroeconomic and microeconomic theories. As discussed earlier, standard econometric techniques used in the analysis of annual crop supply response such as the Nerlovian type specifications are not trouble-free to be applied to the study of a perennial crop supply response due to the unique characteristics of perennial crops.

Based on the review of previous estimation techniques used in perennial crop supply response studies and the nature of the data set at hand, the model developed by French and Matthews (1971) was found most appropriate to be applied for this study. Further, in order to meet the study objectives, the basic model has been extended to include shocks, and zone dummies as additional explanatory variables. The details of both the basic and the extended models are given here under.

The basic model of French and Mathews, (1971) is specified as:

$$Y_t = a_{it} A_{it} + b.T + V_t \quad \ldots\ldots [3.1]$$

Where Y_{it} = average annual yield per ha.

A_{it} = the area covered by trees of age i in year t.

T= Time or trend variable used to capture the effects of technological changes over time.

V_t= Disturbance term which is used to reflect the effects of shocks on the supply response

The extended model used by the current study is given by:

$$Y_{it} = \alpha + \beta_1(plot_{it}) + \beta_2(Labour_{it}) + \beta_3(techno_{it}) + \beta_4(shock_{it}) + \beta_5(zone_i) + \beta_6(Age_{it}) + \beta_7(Agesqr_{it}) + U_{it} \ldots\ldots [3.2]$$

Where Y_{it} = average annual yield per ha.

$plot_{it}$ = area covered by coffee trees of age i in period t

$Labour_{it}$ = the number of household labour participated in coffee production process

$techno_{it}$ = a dummy variable to show the effects of using organic fertilizers on coffee yield

$shock_{it}$ = captures the impact of shocks on yield

$zone_i$ = dummy variable used to show supply response variation across zones

Age_{it} and $Agesqr_{it}$ = age of coffee trees to control for the effects of age on yield

α is the intercept term and in the pooled OLS regression, it measures the supply response of the reference zone.

β_1 to β_7 are supply response coefficients to be estimated.

In order to estimate the supply response, the data obtained through the questionnaire survey was pooled following the method used by Wooldridge (2000) and Greene (2003). Pooling the data obviously makes the estimators more precise and increases the power of the test statistics. Further, using panel data regression techniques, a one-way fixed effects model is estimated to analyze the variation in supply response across regions. This represents a short run supply response. The error component method of Wooldridge (2000) and Greene (2003) pools the available data set as follows:

Let $Y_{it} = \alpha + \beta_1 X_{it} + a_i + U_{it}$ ---[3.3]

Where t = 1,2,…T (T is the number of periods)

i = 1,2,…N (N is number of households or zones)

Y_{it} = Response of economic agent i (farmer i in our case) in period t

X_{it} = Set of explanatory variables

a_i = Farmer specific residual which varies across farmers or zones but constant for a particular farmer. It is an unobserved effect.

U_{it} = an error term with the usual OLS properties.

Taking the two year average (before and after a shock year) or the five zone average (to investigate the supply response variation across zones) for each i results in:

$\overline{Y_i} = \beta_1 \overline{X_i} + a_i + \overline{U_i}$ ---[3.4]

Where $\overline{Y_i} = \sum_{i=1}^{2} Y_{it} \Big/ T$ or $\overline{Y_i} = \sum_{i=1}^{5} Y_{it} \Big/ N$

$\overline{X_i} = \sum_{i=1}^{2} X_{it} \Big/ T$; or $\overline{X_i} = \sum_{i=1}^{5} X_{it} \Big/ N$

$\overline{U_i} = \sum_{i=1}^{2} U_{it} \Big/ T$ or $\overline{U_i} = \sum_{i=1}^{5} U_{it} \Big/ N$

Equation 3.4 is known as the between effect. It describes the response of a typical farmer over a period of time. Thus, this equation can give us some idea about the long-run supply response of farmers to various changes.

The unobserved effect a_i is found in both equation 3.3 and 3.4 and it can be removed by taking the first difference of equations 3.3 and 3.4 as follows:

$(Y_{it} - \overline{Y_i}) = \beta_1(X_{it} - \overline{X_i}) + (U_{it} - \overline{U_i})$ ---[3.5]

This method is called the within transformation method and $Y_{it} - \overline{Yi}$ is called a time-demeaned data. After doing this, the model can be estimated using the Pooled OLS technique because now the unobserved effect a_i has disappeared from equation 3.5. The Pooled OLS estimator that is based on the time-demeaned data is called the Fixed effect or the within effect estimator. In the context of the current study, the within effect estimator measures the short-run supply response of coffee farmers. Here, the term “within effect” signifies that the unobserved effect a_i is fixed over time.

Using a weight δ to show how farmers respond to shocks, one can estimate an overall effect model or a Random effect model as follows:

$$(Y_{it} - \delta\overline{Yi}) = (1-\delta)\alpha + \beta_1(X_{it} - \delta\overline{X_i})$$

$$+ (1-\delta)a_i + (U_{it} - \delta\overline{U_i}) \text{------------------------------------}[3.6]$$

The value of δ depends on the variance of a_i and U_{it}. If var $(U_{it} = 0)$ then δ is set to 1 and it is possible to use the "within effect" estimator to get all the required information. If var$(a_i = 0)$ then δ is set to 0 and hence the between effect equation becomes a valid estimator. In practical work, however, δ lies some where between 0 and 1. A further simplification of equation 3.6 results in a compact equation that captures both the within effect and the between effect as follows:

$$Y_{it} = \alpha + \beta_1\overline{X_i} + \beta_2(X_{it}- \overline{X_i}) + a_i + U_{it} \text{---}[3.7]$$

In equation 3.7, β_1 captures the long run supply response of coffee farmers to shocks over time or it shows the between effect. β_2 on the other hand explains the within effect or the short run supply response across households.

From equation 3.7, it is possible to derive two equations to estimate the short run and long run supply responses separately.

$$\overline{Y}_i = \alpha + \beta_1\overline{X_i} + a_i + \overline{Ui} \text{---} [3.8]$$

$$(Y_{it} - \overline{Y_i}) = \alpha + \beta_1(X_{it}- \overline{X_i}) + a_i + (U_{it}-\overline{U_i}) \text{--------------------------------------}[3.9]$$

Equation 3.8 can describe the between effect or the long run supply response while equation 3.9 can measure the short run supply response.

Variables Used in the Model and Their Expected Signs

The dependent variable for the regression model is yield of coffee trees or the amount harvested (in kilograms) from one hectare of land covered by coffee. During the data pooling process, the average yield is calculated for all households in the study areas. The deviation of output of each household from the average yield ($Y_{it} - \overline{Y_i}$) is taken as a measure of the within effect or supply response variation across zones in the fixed effect model. As discussed in the literature review chapter, estimating the long run supply response of perennial crops requires a time-series data of long years and it is very complicated. Hence, more emphasis is given to the effect of shocks on yield and supply response variation across regions (the short run analysis).

Lags are common in the production of perennial crops and hence a previous period yield data is included in the model as an explanatory variable to capture lag effects. To investigate the supply response variation across the study areas, zone dummies are included in the model. West Hararghe zone is taken as a reference group against which the supply response of other zones is compared. The sign of the regional dummies cannot be predicted in advance because yield in one region may be larger or smaller than the yield in another region.

Estimating supply response models without including the effects of shocks will result in an over estimate of response coefficients and hence shock dummies are included in the model to capture the adverse effects of shocks on coffee production. Since it becomes cumbersome to include all the shock items in the model, the current study focused on major shock episodes, which have got higher priority ranks by coffee farmers in the study areas. Shock dummies, which capture the effects of drought, pests, unpredictable policy changes and health problems are included in the model as explanatory variables. All the shock dummies are expected to have a negative sign because they have an adverse effect on coffee production and yield.

The use of organic fertilizer dummy is taken as a proxy for local technology adoption (e.g. the use of manure, compost etc.) with an expected positive sign. Age of coffee trees is also included in the model to explain the effect of tree age on yield. Coffee is a perennial crop, which begins to yield three years after planting and has a production life up to thirty years. Coffee harvesting follows an inverted U-shape process, that is, low yield during the third and fourth years followed by a maximum yield in the fifth and sixth years, and a lower yield afterwards (Wickens and Greenfield, 1973). As age increases, yield also increases until it reaches some maximum and then it begins to decline. As coffee trees get older, they also become more vulnerable to various coffee diseases and shocks. To capture such a second order effect of age or the inverted U-shape hypothesis, Age Square (Agesqr) is also used as an explanatory variable with a negative expected sign. The regression results are given in chapter four.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Descriptive Statistics

4.1.1 Major Types of Shocks and Their Impact on Coffee Farmers

During the data collection, ETPSA has given a list of shocks to coffee farmers and asked them about the frequency of occurrence of these shock episodes and subjective priority ranking. Since it is beyond the scope of the current study to discuss each in detail, emphasis is given to selected high priority shocks including drought, coffee price fluctuation, pest/diseases, and illness. Table 4.1 summarizes the number of farmers ranking a particular shock as first, second, or third during the periods 1998 to 2005.

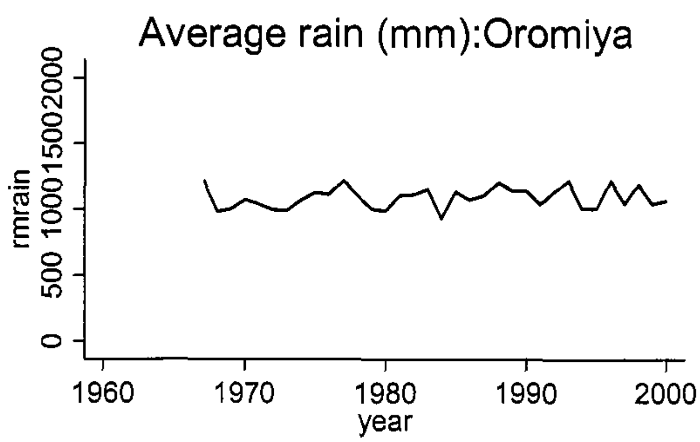
Table 4.1: Number of farmers ranking a shock as a priority

Zone	**Priority Ranking of Shocks**											
	Drought			Coffee Price shock			Pest/disease			Illness		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Sidamo (N= 238)	185	8	8	54	157	45	7	19	14	54	6	5
Jimma (N= 241)	19	6	13	82	156	24	14	16	14	64	9	7
Illubabor (N= 232)	25	17	6	22	132	20	21	26	24	26	3	4
Wolayta (N= 132)	96	6	5	2	75	10	11	33	25	72	5	7
W/Hararge(N= 190)	165	14	3	3	137	19	0	18	20	90	6	4
Overall Total	**490**	**51**	**35**	**163**	**657**	**118**	**53**	**312**	**97**	**306**	**29**	**27**

Source: own tabulation from the survey data

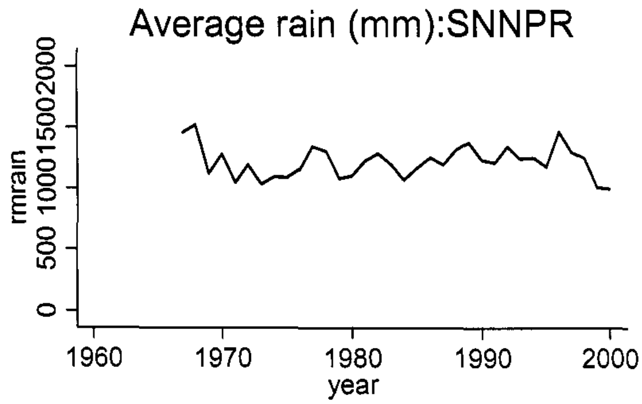
Drought: is the most serious natural hazard to coffee production. As shown in Table 4.1, farmers in many case study sites identified drought as the most serious shock item that affects coffee production. According to World Bank (2005) report, in Ethiopia, rainfall is generally low and unevenly distributed. Figure 4.1.a and b show the realized annual average rainfall over the last 30 years in SNNPR and Oromia regions (The five survey zones were selected from these regions). The average annual rainfall is about 1100 mm, all of which is realized within a period of 5 months, split in to two major rainy seasons.

Figure 4.1.a.: Average Annual Rainfall in Oromia region



Source: World Bank, 2005

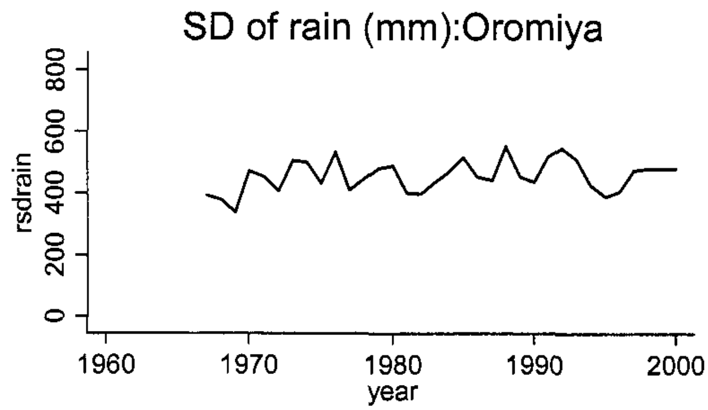
Figure 4.1.b.: Average Annual Rainfall in SNNPR



Source: World Bank, 2005

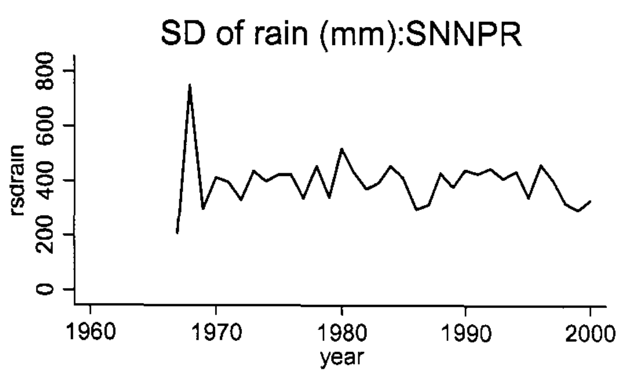
The other striking observation about the rainfall pattern is that it is very volatile (Figure 4.2.a and b). The standard deviation (SD) is about 400mm, which is almost 40% of the long run mean annual rainfall (World Bank, 2005). In these figures, the deviation for each year is obtained from average rainfall reported over various regions of the country in each year. Hence the standard deviation demonstrates that there are potentially large spatial variations in average rainfall across regions. This high variability of rainfall both across regions and over time is a clear indication of risk and it leads to frequent droughts. Between 1978 and 1994 alone (i.e. within 16 years time period), there were 15 droughts and famines that have led to the displacement, injury, or death of more than a million people in Ethiopia (Ibid).

Figure 4.2.a: Standard Deviation (SD) of rainfall from the annual mean rainfall in Oromia



Source: World Bank, 2005

Figure 4.2.b: Standard Deviation (SD) of rainfall from the annual mean rainfall in SNNPR



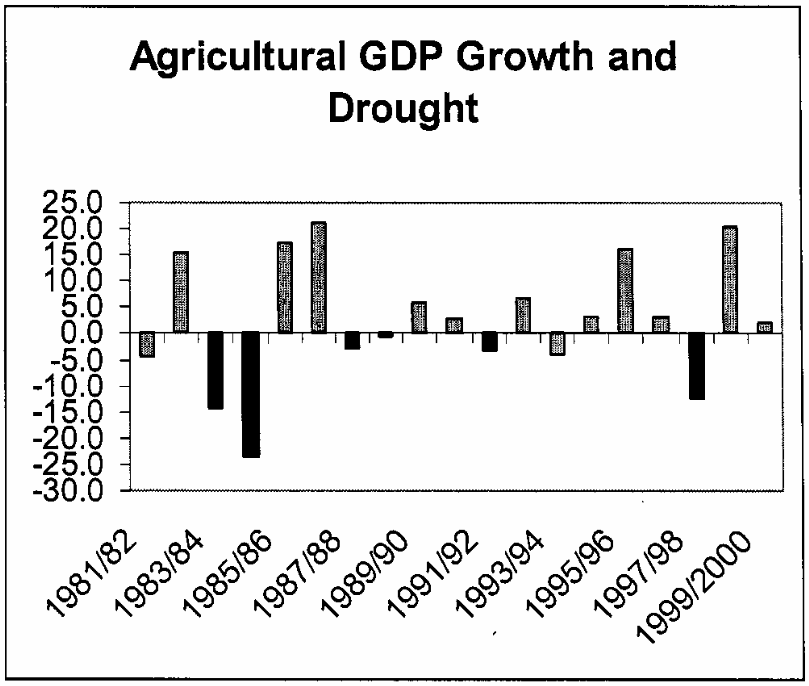
Source: World Bank, 2005

Table 4.1 also shows that the relative importance of drought varies across zones with the highest occurrence in West Hararghe, Sidamo and Wolayta areas. These are densely populated and deforested areas in Ethiopia, which have been subject to climatic variation, food insecurity, and frequent famine. As would be expected, Jimma and Illubabor areas are least affected by drought. This is presumably because of the existence of the dense natural forest that provides ecosystem functions including watershed protection, control of soil erosion and regulation of the microclimate. Indeed, the South Western half of the Ethiopian highlands generally receive high annual rainfall and are least affected by drought, explaining why drought is a less frequent risk in this agro ecological region.

Drought also has a very serious ex-post effects on human life. For example, the 1984 drought killed about one million Ethiopians. In the year 2000 about 10 million people were hungry and in 2001 about 6.2 million people needed emergency food aid (FEWS, 2002).

According to a study by Easterly (2002), droughts occurred in 1983/84, 1984/85, 1987/88, 1991/92 and 1997/98 have all led to about 25% of agricultural output loss (Figure 4.3).

Figure 4.3: The effect of drought on Agricultural Growth, Ethiopia, 1981/82 – 1999/2000



Source: William Easterly (2002)

Coffee price shock is another major risk factor, which affected Ethiopian coffee growers severely. Tables 4.2 and 4.3 summarize the impact of shocks on coffee production and household income. The year 2001/02 was the worst shock year to coffee farmers in Ethiopia. Table 4.1 shows that farmers in the study areas have ranked coffee price shock as a high risk factor next to drought.

The imbalance between demand and supply for coffee in the world market led to a drastic fall of coffee price. Global production of coffee in year 2001/02 was around 113 million bags (60-kg bags) while world consumption was just over 106 million bags. On top of that, world stocks amounted to some 40 million bags. In the same period, coffee production has risen at an average annual rate of 3.6%, while demand had increased by only 1.5% (ICO, 2002). At the origin of this coffee glut lies the rapid expansion of production in Vietnam and new plantations in Brazil. Prices on world markets, which averaged around 120 US cents/lb in the 1980s, declined to around 50 cents in the year 2001/02, the lowest in real terms for 100 years (Ibid). The drop in earnings is particularly severe for those countries such as Ethiopia where coffee provides a large portion of export revenues.

At national level, the unit price of coffee has fallen from Birr 20.87 per kg in 1998/99 to Birr 12.63 in 2001/02. This led to a reduction of Birr 718,904,000.00 in the value of coffee exported (Table 4.3).

At zone level, more than 60% of coffee farmers in Jimma, Wolayta and West Hararghe zones have reported that they lost their income from coffee due to drought and the severe world coffee price shock in year 2001/02. Farmers in Illubabor, West Hararghe, and Jimma zones have lost, on average, an income of Birr 313.30, 310.00, and 298.00 respectively because of the coffee price shock (Table 4.2).

Such loss or reduction in household income means farmers cannot cover their basic production costs and are operating at loss. As income reduces consumption also reduces because farmers cannot afford for the ever-escalating food prices. They become unable to pay for vital medical expenses and cannot pay their children's school fee. It also forced farmers to sell their livestock at low prices to buy food and clothes (Table 4.5).

Following the 2001/02 world market price failure, twenty five percent of coffee farmers in West Hararghe zone have uprooted coffee trees and replaced them by other less risky crops (Table 4.5). Farmers know that coffee production is profitable but it is risky, and hence they choose to plant other less risky crops at the expense of the more profitable opportunity. This means that they choose poverty due to risk.

Table 4.2: Average Quantity sold and income earned before and after the shock periods

Zone	year	Average Qty sold(kg)	Average income (birr)	Unit price (birr/kg)	Change in Qty (kg)	Loss in income (birr)	Percentage of farmers reported income loss
Sidamo	1998/99	245	468	1.90			
	2001/02	155	248	1.60	-90	-220.00	44
Jimma	1998/99	303	515	1.70			
	2001/02	161	217	1.35	-142	-298.00	65
Illubabor	1998/99	438	728	1.67			
	2001/02	286	414.70	1.45	-152	-313.30	48
Wolayta	1998/99	300	420	1.40			
	2001/02	198	198	1.00	-102	-222.00	63
W/Harrarge	1998/99	300	570	1.90			
	2001/02	220	260	1.18	-80	-310.00	62

Source: own calculation from the survey data

Table 4.3: Value, Volume and Unit Value of coffee Export During the Period 1984/85-2003/04

Coffee Years	Value of Coffee Export (in thousands of Birr)	Qty of Coffee Export (in metric Tons)	Unit value of Coffee Export Item (Birr/kg)
1984/85	466,269	73,834	6.32
1985/86	664,790	69,999	9.50
1986/87	524,348	80,216	6.54
1987/88	439,181	71,165	6.17
1988/89	626,448	92,141	6.80
1989/90	405,103	88,916	4.56
1990/91	268,451	58,232	4.61
1991/92	168,324	32,249	5.22
1992/93	536,982	67,375	7.97
1993/94	718,019	69,160	10.38
1994/95	1,799,034	82,190	21.89
1995/96	1,724,008	97,579	17.67
1996/97	2,307,394	123,166	18.73
1997/98	2,889,531	120,050	24.07
1998/99	2,112,713	101,232	20.87
1999/00	2,133,646	116,558	18.31
2000/01	1,520,101	99,134	15.33
2001/02	1,393,809	110,347	12.63
2002/03	1,418,324	126,128	11.25
2003/04	1,926,679	156,409	12.32
2004/05	2,901,554	161,100	18.02

Source: National Bank of Ethiopia, Annual Report, 2004/05

According to a study by Mekuria et.al., (2004), the collapse of world coffee prices has contributed to a socio-economic decline affecting an estimate of 125 million people world-wide. In Ethiopia, the fall in farmer and government revenues amounted to 42% within a year. According to the SNNPR Bureau of Agriculture, the 2001/02 prices of coffee declined by 62% compared to that of 1997/98. Similarly, the report of the Oromia region revealed that the price of red cherry coffee decreased by 70% and that of dry coffee by 40% between 1998/99 and 2001/02 (GOE, 2002C). Such significant fall in household income means denial of basic human needs such as food, health care, and education.

Pest and Disease: Compared to other zones, farmers in Illubabor and Jimma reported pest and disease as their second major risk factor in coffee production (Table 4.1). Field and storage pests such as wild animals and rodents have been estimated to cause losses of about 13% of the world yield but are most serious in Africa, particularly where Arabica coffee is grown (Richard, 1978). Among the common diseases, Coffee Berry Disease (CBD) is a very serious disease caused by a fungus and infects all stages of the crop from flowers to ripe fruits. It occasionally infects the leaves of coffee trees but maximum crop losses occur when the green berries are infected. This disease was first reported in Kenya in 1922 and it causes up to 70-80% of yield loss if no control measures are adopted (Mc Donald, 1926; Waller, 1985).

The survey data of the current study showed that the effects of CBD are severe in climatically wet and humid areas such as Illubabor and Jimma. For instance, 20% of the farmers in Jimma and 31% in Illubabor zones have reported that they lose 50% of their coffee yield due to CBD. This presumably explains why farmers in these areas ranked coffee disease as a major constraint to coffee production.

Widespread CBD infestation was reported in the 1970s in the regions of Sidamo, Kaffa, Illubabor, Harar and Wollega (Tessema, 2001). To control the disease, in the period between 1978 and 1990 alone, on average about 8,000 hectare of coffee fields were sprayed against CBD consuming over 120 tones of chemicals per year (Ibid). Selection and development of CBD resistant varieties has also been a major research effort to mitigate yield loss due to CBD.

Other major coffee diseases include coffee leaf rust, powdery rust, and yellow rust. The major symptom of leaf rust is that it creates a dusty or powdery coating covering the underside of the coffee leaves (Rodrigues, 1990; Adejumo, 2005).

Coffee wilt disease is also common in countries where coffee Arabica is grown. It is a vascular disease causing yellowing and wilting of coffee trees (Ibid).

Coffee bark disease is also found in Ethiopia, Kenya, Malawi and Tanzania (Waller, 1985; and Chen, 2002). Its characteristic symptom is a scaling of the bark leading to stem cankers and a progressive dying back of the whole tree. The brown eye spot or berry blotch is another coffee disease of widespread occurrence in nurseries and plantations, infecting the coffee leaves and the fruits as well (Waller, 1985).

Illness: A single episode of illness to the main income earner of the household for an extended period of time can be the difference between life and death of the household members. The effect of illness is greatly perceived in Jimma, Wolayta and West Hararghe areas. The real cause for this is not properly understood. But it is possible to assume that this might be due to the prevalence of malaria and HIV/AIDS pandemic in these areas. HIV/AIDS and Malaria are known to be the major health challenges killing thousands of the Ethiopian work force.

Malaria remains to be a persistent risk in most areas of the country. The World Bank report of 2005, estimated that about 40% of the population is at risk of malaria and about 24% live in areas where malaria risk exceeds the expected level.

According to the report of the Ministry of Health (MOH), the total number of adults and children infected with HIV/AIDS as of 2006 is estimated to about 1.32 million. Out of which 634,000 are living in rural areas and the prevalence of HIV in rural areas (farming communities) is 1.9% (MOH, 2006)

Such prevalence and pattern of the spread of HIV is closely related with patterns of seasonal economic migration of people to coffee growing areas. Usually, bar-tender women migrate seasonally from Nazreth, Shashemene, Awassa, Jimma, Nekempte and Addis Ababa to nearby coffee trading towns like Dilla, Aleta Wondo, Yirga Cheffe, Agaro, Metu, Gimbhi, and Dembi Dollo, mainly to seek sex work during the months of October to February (Tessemma, 2006).

This is the time when coffee farmers have access to cash from coffee sales. During these harvest seasons, the highly decorated and eye catching bars flourish at all corners of coffee trading centers and farmers come to these bars. Once male are in the bar and had some liquor, they eventually be aroused to sexual entertainment by those fancy sex-work ladies and the farmers purchase HIV by their coffee income.
According to a survey by HAPCO (2002), most of the ladies who migrate from cities to the coffee trading towns are HIV positive and obviously become the main source of the disease to coffee farmers (Table 4.4).

Table 4.4: Women Testing HIV Positive in Cities

City	**Sample Size**	**HIV Positive (%)**
Dilla	347	9.8
Jimma	467	8.6
Metu	334	10.5
Nekempte	495	9.1
Awassa	400	10.0
Shashemene	487	13.1
Nazareth	417	18.7
Addis Ababa	296	15.6

Source: HAPCO, 2002

HIV/AIDS leads to a serious depletion of skilled and productive household labor force and erosion of technical knowledge about the local coffee farming skills, and loss of indigenous Knowledge systems and technology adoption by farmers to suit the particular conditions of specific zones.

Generally, shocks have a chain effect. For instance, if drought occurs in a given production year, yield will decline and hence marketable surplus will reduce and this will lead to a reduction of household income which in turn reduces household consumption and asset holding. The end result will be a leap in to a severe poverty trap.

4.1.2 Household Risk Management Strategies

Faced with large number of shocks, coffee farmers have developed various methods to minimize the bad consequences of shocks. The various risk management strategies adopted by Ethiopian coffee farmers in the study areas are presented in Table 4.5 below. These strategies can be identified as household level and community level risk management strategies.

Table 4.5: Risk Management Strategies employed by farmers in the study areas (Numbers in bracket are Percentages)

Household level Risk management strategies					Community level Risk management strategies			
Zone	Inter-cropping	Depleting assets	Borrowing	Uprooting coffee trees	Coffee growers/marketing cooperative membership	Participation in Debo (Labour Exchange)	Iddir member ship	Iqqub member ship
Sidamo (N= 238)	176(74)	127(53)	110(46)	48(20)	218(92)	157(66)	197(83)	22(9)
Jimma (N= 241)	38(16)	36(15)	104(43)	6(2)	114(47)	171(71)	227(95)	3(1)
Illubabor (N= 232)	54(23)	78(34)	80(35)	12(5)	38(16)	189(81)	141(61)	15(6)
Wolayta (N= 132)	107(81)	81(61)	71(54)	31(23)	53(40)	89(67)	125(95)	39(30)
W/Harrarge (N= 190)	154(81)	79(42)	101(53)	48(25)	45(24)	163(86)	66(35)	9(5)
Overall	**529(51)**	**401(39)**	**466(8)**	**145(14)**	**468(45)**	**769(74)**	**756(73)**	**88(6)**

Source: own calculation from the survey data

- ## Household Level Risk Management Strategies

Household level risk mitigation strategies include intercropping as crop diversification strategy, selling livestock assets, borrowing money from various sources, and uprooting the more risky coffee trees and replacing them by other less risky crops.

Intercropping: Means growing two or more crops together on the same plot of land in the same production period. For example, farmers may grow cereals with pulses/legumes and coffee with undergrowth of maize, vegetables and spices. The survey result reveals that more than 70% of the households in Sidamo, Wolayta and West Hararghe zones practiced intercropping coffee with other crops to minimize their exposure to risk.

The economic rationality behind intercropping is that if one crop fails the other may bear some fruit and the household may compensate the loss at least partially. Farmers in Wolayta area usually intercrop coffee with vegetables and spices while in West Hararghe, coffee is grown with chat and maize or sorghum (Eyasu, 2002).

Since each crop has different capacity to resist drought and disease, different resource requirements and different potential uses, inter cropping is meant to reduce the vulnerability to the risk of crop failure. This is inline with the main stream literature on intercropping. For example, Scoons et.al., (1996) argue that farmers know, from their long-lived experience, the characteristics of the soils of their plots, the characteristics of the crop varieties and the likely responses to different rainfall conditions. Hence they know which crops to grow together. In the words of Scoons et.al.,(1996), inter cropping depends on the following criteria:

"Different crops have different level of susceptibility to drought, pest attack or poor soil conditions. Also different crops have different levels of input requirements whether seed, fertilizer or labour for production or processing; different crops have different properties of taste, storage for home consumption, or market price and sale potential for cash income, and different crops have different socially defined roles and status levels" (Scoons et.al., 1996).

From the above discussion and survey results it is clear that intercropping is one of the important risk reducing (ex-ante) strategies employed by coffee farmers in the study areas.

Depleting assets: Farmers build assets in good times and deplete them in bad times to smooth their income and consumption. Fifty three percent of the households in Sidamo, 61% in Wolayta, 42% in West Hararghe and 34% in Illubabor zones have depleted their assets (usually by selling their livestock) to smooth their consumption during the shock years (Table 4.5). Farmers are rational in deciding to deplete their assets to survive today, because they can purchase these assets back in the future when things improve. It is an inter-temporal smoothing of consumption which enables a household to spread the effects of shocks forward through time. It is a strategy to access sufficient funds to recover from a loss caused by a risky event. Scholars also agree with this ex-post risk coping strategy as a feasible and rational method to manage risk (e.g. Alderman and Paxson, 1992; Brown and Churchil, 1992).

Borrowing: Credit is one way through which farm households smooth their consumption in cases of income fluctuation due to various shocks. More than 50% of coffee farmers in Wolayta and West Hararghe zones borrowed money from various sources to cope-up with the ex-post effects of shocks. Due to lack of formal credit institutions and the very high interest rates of the local money lenders, households in the study areas depend on friends/relatives and informal institutions such as iddir and iqqub as a source of cash during the times of accidents or illness. For instance, more than 80% of the households in the study areas reported that they cover funeral expenses from the money they get from iddir while 12.5% of the households met their medical and educational expenses by borrowing from friends or relatives. Furthermore, the survey result shows that 7.3% of the households in the study areas did not borrow because loan is not available and 4.2% applied for credit but their application was rejected.

Scholars also agree that credit (whether reciprocal or interest bearing; from formal or informal sources), is a very important consumption smoothing method during bad days (e.g. Udry, 1994 and Eswaran and Kotwal, 1989). Credit serves the role of insurance and it also affects the level of investment and technology adoption in agriculture. For instance, farmers in the study areas reported that they require credit to buy farm tools, fertilizers, livestock and other inputs to production. Credit can also smooth household income and consumption when crop fails, oxen die, asset is destroyed by fire or arson and income is lost due to a reduction in output price. It can also be used to buy food and other consumption items, to build asset and to maintain social interactions.

Uprooting: is another risk management strategy. When income earned from one crop reduces due to various shocks, farmers uproot that crop and replace it by other less risky crops. Twenty three percent and 25% of households in Wolayta and West Hararghe zones respectively have uprooted coffee trees due to shocks and replaced them by other crops such as chat.

- **Community Level Risk Management Strategies**

Farm households voluntarily share with their less fortunate neighbors in the hope that their neighbors will help them out at the time of risk. This is an endogenously enforced risk sharing strategy because it does not depend on any external norms or authority to function (Carter, 1997). Such mutual assistance groups are built upon kin relationships, neighborhood, or faith.

The rationality behind such collaboration is that an organized group of people can achieve more than individual. By its very nature, agriculture requires cooperation of farm households. One farm household alone cannot perform all tasks. Some farming practices require division of labour. Thus inter-household cooperation is one way through which poor farmers get access to community level resources. Agricultural mutual assistance groups like iddir, iqqub, and debo (labour exchange) are very common risk sharing strategies in the study areas (Table 4.5).

Membership in coffee farmers' cooperatives: Coffee farmers are highly exposed to the hazards of both domestic and international free market competition. They suffer from export price fluctuations, which are beyond their control. Ethiopian coffee, accounting for only 4% of the world's export amount, has almost no influence on international prices (ICO, 2006).

In such situations, the role of cooperatives is crucial. According to the cooperative societies proclamation No. 147/1998, a cooperative is defined as an organization formed by individuals on voluntary basis. This proclamation permits four layers of organizational structure of cooperatives: primary cooperatives, unions, federations, and cooperative leagues.

Currently, in Ethiopia, only the primary and union levels have been formed (Dorsey and Tesfaye, 2005). Following the issue of proclamation No. 147/1998, six coffee farmers cooperative unions were established. These are: Oromiya Coffee Farmers Cooperative Union (OCFCU), Sidama Coffee Farmers Cooperative Union (SCFCU), Yirga Cheffe Coffee Farmers Cooperative Union (YCFCU), Kafa Forest Coffee Farmers Cooperative Union (KFCFCU), Tepi Coffee Farmers Cooperative Union (TCFCU), and Bench Maji Forest Coffee Producer Farmers' Cooperative Union.

Cooperatives play an effective role in supporting coffee farmers by supplying the price information, providing inputs and capital, and transportation services that small-scale farmers lack.

For instance, Oromiya Coffee Farmers Cooperative Union (OCFCU) distributes Seventy percent of the Union's profits from selling and exporting coffee back to its 115 cooperatives. The cooperatives then distribute these dividends back to the farmer-members or to reinvest in capacity building assets. The other 30 percent of the Union's profits are used for expansion of capacity building assets, for community development and for reserves against poor harvest or shock years (OCFCU, 2007). This shows that cooperatives also help coffee farmers to manage risk better.

Cooperatives also serve as a strong negotiator than an individual farmer in the international market. According to proclamation No. 147/1998, coffee cooperative unions are privileged to skip coffee auctions in which private traders are obliged to participate.

Cooperatives make the coffee marketing route shorter and benefit coffee farmers a lot. In the cooperative marketing route, a cooperative purchases coffee from farmers at the market price and delivers it to a union and the union directly exports the coffee through a fair-trade route. In the absence of cooperatives, coffee marketing passes through a long conventional chain and coffee farmers get little benefit from their coffee. In the conventional route, coffee producers sell their coffee to collectors who in turn sell to wholesalers. The wholesalers deliver the coffee to the Addis Ababa auction center from which exporters buy the coffee at the prevailing auction price.

Although the membership rate is lower in Illubabor and West Hararghe zones, the survey result shows that 92% of coffee farmers in Sidamo zone and more than 40% in Jimma and Wolayta zones are members of coffee growers' cooperatives.

Iddir: is an indigenous institutional arrangement in which members regularly contribute to a common pool (in cash or in kind) with a view to supporting a needy member (Dejene, 1993).

Table 4.5 shows that more than 80 % of the farm households in Sidamo, Jimma, and Wolayta zones of the study areas are members of at least one type of iddir. Thus iddir is one of the risk sharing mechanisms used in the study areas. The objective of such iddirs is beyond burying the dead and providing financial and material assistance to the surviving members of the household.

Above that, the iddir also serves as a means of social security. If a member of the iddir becomes unable to make the regular contribution due to age, or disability, then the member will apply for exemption. If the general assembly accepts his application, he will be exempted from any contribution and service to the iddir but benefits equally from the iddir (Sissay, 2001). This is a good example of social security function of indigenous institutions like iddir.

Iqqub: is a form of rotating savings and credit association (ROSCAS) specific to Ethiopia. Members contribute to a common pool on a regular basis and collect funds by drawing lots or by other means (Dejene, 1993). It is another important indigenous risk management mechanism adopted by Ethiopian coffee farmers (Table 4.5). The amount they get from the iqqub (the payout from the pool) is basically used to buy livestock to build asset as a hedge against risk, to invest the money in income-generating activities, and to help the members of the community who are in distress.

Debo (Labour exchange): is a form of labour exchange or mutual assistance whereby a household, which happens to be short of labour, oxen or both during a given agricultural season, calls on friends and relatives for help. Except Wolayta zone, more than 65% of Ethiopian coffee growers residing in the study areas participate in debo as a risk reducing strategy (Table 4.5). It is one way to get access to community labour and oxen and hence can be considered as an inter household relationship that reduces the vulnerability of the rural households to various shocks. It is a system of helping each other, which households utilize in crucial times such as illness of the household head, birth of a child during a peak season, unexpected away of boys from the household, imprisonment, and accidental death of oxen.

Detailed theoretical and technical matters of iddir, iqqub and debo can be found in the works of (Dejene 1993, 1998, 1999; Sissay, 2001; and Yared, 1999).

4.2 Empirical Results

Determinants of Coffee Supply Response

The empirical results of the regression model are presented in Tables 4.7 to 4.11. After estimating the initial Pooled OLS model, a test for hetroskedasticity was conducted and the variance of the error term found to be hetroskedastic (Table 4.7). Hence the standard errors were corrected for hetroskedasticity and presented in Table 4.8.

Table 4.6: Yield variation across the study areas

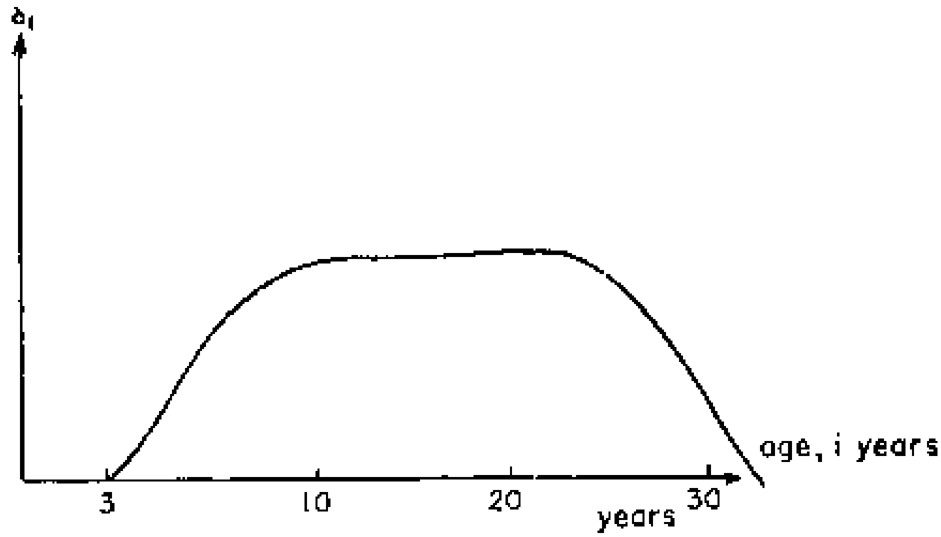
Zone	Average yield (kg / ha)
Sidamo	490
Jimma	489
Illubabor	242
Wolayta	504
W/Hararghe	309

Source: own calculation from the survey data

As one more household labour is engaged in coffee production activities such as tree planting, weeding, pruning, harvesting etc, on the average, yield increases by 0.65kg per hectare (Table 4.8). More than 60% of the farmers in the study areas reported that they allocate more labour to coffee production when coffee price increases. This is one evidence for a positive supply response.

The productivity of coffee follows an inverted U-shape. Lower yield is expected at the early age of the trees; yield increases as age increases until it reaches some maximum and then starts to decline (Figure 4.4).

Figure 4.4: Coffee yield curve



Source: Wickens and Greenfield (1973)

The empirical result also confirms to this fact. The tree age variable has a positive coefficient of 2.55, which means that as tree age increases by one year, on the average, yield also increases by 2.55 kg. The age square variable on the other hand captures the second order effect of tree age. It has a negative coefficient of 0.085 which implies that yield declines by 0.085 kg/ha per year after a given number of years.

All the shock dummies have a negative sign as expected and except the policy change variable, all have a statistically significant adverse impact on coffee production. For example, a drought incidence in a given production year will reduce the yield of coffee on the average by 51 kg per hectare other things being constant. Pests and coffee diseases also have a serious adverse effect on coffee production. A decrease of yield by about 138 kg due to pest infestation means a lot to a farmer in terms of income loss.

The test for the joint significance of shock dummies indicated that all the shock dummies are jointly significant in decreasing coffee yield (Table 4.9). Joint significance of shock dummies implies that one shock aggravates the impact of the other shock and all the shocks being together hit the farmer hard.

One objective of the current study was to investigate the supply response variation across the study areas. This is captured by zone dummies and taking west Hararghe zone as a reference group (arbitrary choice) to avoid dummy variables trap. The intercept term captures the supply response of the reference group and hence yield per hectare in West Hararaghe zone is about 388 kg/ha. Compared to West Hararghe zone, yield is higher in Sidamo, Jimma and Wolayta zones while it is less in Illubabor zone. For instance, yield in Wolayta zone is more by about 44 kg/ha compared to West Hararghe zone. The economic reasons for such yield variation across the study areas include: difference in land Productivity (soil fertility), difference in asset ownership, difference in vulnerability to shocks, household labour participation in coffee production, and other ecological differences such as extent of land degradation and deforestation.

The estimation results of the fixed effect and random effect models are presented in Table 4.11. To choose the right specification, a Hausman test is conducted and the test result suggested the use of the fixed effects model (Table 4.10).

In the fixed effects (FE) model, to capture the within and the between effects, the data set is grouped by zone and hence there is no need to include zone dummies in this specification.

As discussed in the methodology section, the R^2 (within) measures the short run supply response or yield variation across zones. The R^2 (between) on the other hand gives some idea about the long-term supply response.

As shown in Table 4.11, both the within and the between $R^{2'}$s are significant. However, the R^2 (within) is lower than that of the R^2 (between). This is correct because coffee is a Perennial crop and requires a longer period of time to respond to a shock significantly. A coffee farmer should wait at least for a year to see the impact of a given shock on the yield of the trees.

Sigma-U measures the standard deviation of the fixed error component (the unobserved heterogeneity) while sigma-e measures the standard deviation (SD) of the idiosyncratic error term. The value of rho on the other hand, estimates the correlation of the unobserved heterogeneity and the regressors. The fixed effect (FE) model is robust to such correlations and also other estimates it produces are unbiased (Wooldridge, 2002; Greene, 2003).

The previous period yield is included in the fixed effects model to capture lag effects. It has a negative coefficient and statistically significant. This implies that the previous period yield adversely affects the current yield. The probable economic reason is that land productivity declines as it is cultivated year after year without augmenting the production system using modern technologies and sound agricultural practices. On the other hand, applying organic fertilizers can improve land productivity by about 9 kg per ha. In the fixed effects model, the household asset indicators (a set of control variables), technology variables, and shock dummies have the expected signs and except the health problem regressor, they are also significant.

Table 4.7: Hetroskedasticity Test

Breusch-Pagan (BP) test (Breusch and Pagan, 1980)	
H0: Constant variance; **Variables:** fitted values of yield	
Chi^2 (1)	41.24
Prob > chi^2	0.000
Conclusion: Reject H0 and fit Hetroskedasticity Robust model	

Table 4.8: Coffee Supply Response: Hetro-Robust Pooled OLS estimation

	Hetro-Robust Pooled OLS Results	
Dependent variable: Output per hectare (yield)	Coefficient	t-value
Constant term	388.0651	4.95
Control variables		
Household Labor engaged in coffee production	.6507	2.11
Average age of Existing Coffee trees	2.5012	1.89
Square of tree age – to know second level effect of age	-0.0859	-2.76
Effect of Shocks on coffee production		
Effect of Drought	-51.0953	-2.15
Effect of Pests/disease	-137.7435	-3.58
Effect of Health Problems (Illness)	-6.4651	-3.19
Effect of policy change	-29.5142	-1.66
Adoption of local Technology (e.g. organic fertilizers such as manure, compost, dung etc.)		
Effect of manure on coffee yield	8.0284	4.54
Coffee yield Variation across zones (W/Hararghe is Reference Group)		
Zone 1 (Sidamo)	128.6003	2.32
Zone 2 (Jimma)	35.1864	2.56
Zone 3 (Illubabor)	-41.9789	-2.67
Zone 4 (Wolayta)	43.7852	1.69
Sample size	1012	
F(13, 998)	3.58	
Prob > F	0.000	
R^2	0.47	

Table 4.9: Test for the Joint Significance of shock Dummies

Joint Significance of shock Dummies	
H0: drtdmy = pestdmy = healthdmy = policydmy = 0	
F (4, 1008)	3.23
Prob > F	0.000
Conclusion: Reject H0 and conclude that shock dummies are jointly significant	

Table 4.10: Hausman Test

The hausman test is used to test the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are the same (insignificant P-value and Prob > chi^2 larger than .05) then the random effects model should be used. If the P-value is significant, then the fixed effects model becomes the appropriate specification (Hausman, 1978).

Test: Ho: difference in coefficients is not systematic

$chi^2(6)$ = 24.16

Prob > chi^2 = 0.004

Conclusion:

The null hypothesis is rejected because the test returns a significant result. There are systematic differences between the parameter estimates of the RE and FE models. Therefore it is safe to fit a fixed effects model.

In other words, the random effects and the regressors are correlated. When they are correlated, it is recommended to fit a FE model.

Table 4.11: Coffee Supply Response: Fixed effects and Random Effects Model
Data Grouped by: Zone variable

Fixed and Random Effect Models				
	Fixed Effects model		**Random Effects model**	
Dependent variable: Output per hectare (yield)	***Coefficient***	***t-value***	***Coefficient***	***t-value***
Constant term	175.8221	3.82	158.4474	3.35
Control variables				
Household Labor engaged in coffee production	3.1971	2.79	6.0720	2.48
Average age of Existing Coffee trees	2.5715	2.28	1.8253	2.95
Square of tree age – to know second level effect of age	-0.0856	-1.98	-0.0421	-1.99
Lag Effects				
Effect of Previous period yield on current yield	-.0742	-2.36	-0.0912	-1.85
Adoption of local Technology (e.g. organic fertilizers such as manure, compost, dung etc.)				
Effect of organic fertilizers on coffee yield	9.2620	4.39	8.1816	4.36
Effect of Shocks on coffee production				
Effect of Drought	-53.6929	-2.03	-57.0105	-2.42
Effect of Pests/diseases	-134.0852	-2.58	-42.0696	-2.75
Effect of Health Problems (Illness)	-12.7395	-1.57	16.7002	4.72
Effect of policy change	-9.2257	-1.33	-48.3711	-1.70
R^2 Within	0.08		R^2 Within	0.05
R^2 Between	0.77		R^2 Between	0.80
R^2 Overall	0.04		R^2 Overall	0.07
F(10, 1002)	3.15		WALD CHI(10)	35.46
Prob > F	0.000		Prob > Chi^2	0.000
Sigma_u	96.61		Sigma_u	0
Sigma_e	226.67		Sigma_e	226.66
Rho	0.154		rho	0
Corr(u_i, xb)	-0.29		Corr(u_i, xb)	0
F(4, 1008)	8.29			
Sample Size	1012		Sample size	1012

CHAPTER V

CONCLUSION AND POLICY IMPLICATIONS

The current study tried to uncover the adverse effects of shocks on coffee production and investigated the supply response variation across Ethiopian coffee growing zones. The study showed that due to severe poverty and lack of insurance and credit markets, smallholder coffee growers remain vulnerable to a wide range of shock episodes. The major sources of shocks, their distribution across coffee growing zones, impacts on household income and yield, and some coping mechanisms were discussed in this paper.

The regression results showed that shocks have a serious adverse effect on coffee production. For instance, ceteris paribus, on the average, yield declines by 51 kg due to drought, 138 kg due to pest and disease infestation, 6.5 kg due to health problems, and 30 kg due to unpredictable policy changes (Table 4.8). This implies that Ethiopian coffee farmers are vulnerable to all kinds of shocks, both natural and man-made. Moreover there is a real difference in supply response across the study areas or there is a significant short run supply response variation (the within effect). Although the long run supply response analysis requires a time series data for many years, the between effect estimator shed some light on the behaviour of the long run supply response. The effects of the shocks are very serious on the livelihood of the households and on coffee production. Shocks led to a decline of productivity, loss of household income, consumption reduction, and in some areas, even abandoning coffee production. Hence managing risk and reducing its impact on coffee production is crucial to improve the productivity of the coffee sub sector.

Several implications can be drawn from the current study for policy formulation both for economic and cultural changes in the coffee growing areas of the country. A number of research and policy supports are needed to reduce the vulnerability of coffee farmers to shocks and further improve their productivity. Key among these include the following.

5.1. Reducing the impacts of shocks

The study has demonstrated that shocks are among the major factors affecting coffee production in Ethiopia. Due to poverty, technology backwardness, lack of insurance and credit markets, smallholder farmers remain vulnerable to a wide range of shock episodes that persist year after year. For instance, shocks such as drought, plant pests and diseases, and health problems have a serious effect on coffee production and household income.

Some of the major drought risk management strategies include dissemination of drought-resistant coffee varieties, investment on small-scale irrigation schemes, controlling erosion by planting trees and increasing public awareness about preventing drought episodes. Harvesting rainwater is one feasible way to respond ex-ante to the risk of crop failure due to drought. Availability of a regular water supply would encourage households to focus on high value cash crops such as coffee and chat.

The survey result showed that only 5% and 31% of the coffee farmers in Wolayta and West Hararghe zones respectively (highly drought–prone zones) use small or traditional irrigation on their plots. This shows that farmers lack either the knowledge or financial capacity or both to make use of irrigation facilities and water harvesting schemes. It requires the intervention of the extension staff in creating awareness and communicating the problems of farmers with concerned government bodies.

The research implication of coffee pests and diseases is that it is required to give due attention to research on coffee. There is a strong consensus that growing genetically resistant coffee varieties is the most appropriate, cost effective and environmentally friendly means of managing coffee diseases. It is also one of the key components of improving yield (Maria, et. al., 2006). In the past decades, the Jimma Agricultural Research Center has selected and released a number of CBD resistant coffee varieties. However, these varieties have not been widely disseminated among coffee farmers in Ethiopia mainly because the government stopped subsidy to farmers following the policy change in 1992 (Tessema, 2001). Thus it is recommended that concerned stakeholders in the Ethiopian coffee sub sector should invest on coffee research that takes into account the environmental needs and the development of a sustainable coffee economy. In particular, the agricultural extension work has to multiply and disseminate improved high yield coffee lines which are drought and disease resistant.

HIV/AIDS is eroding the social, economic and technical dimensions where a sustainable coffee production has depended for centuries. Therefore, a priority should be given to building awareness on HIV/AIDS. Extension workers should teach coffee farmers how HIV reduces the skilled and productive household labour force, how it erodes the coffee knowledge base that is vital for sustainable land use and conservation of biological resources, and how it affects the national economy.

As discussed earlier, during the coffee harvest seasons, farmers get access to cash from coffee sales and are highly tempted by the decorated town bars and fancy bar-tender women who infect their clients with HIV/AIDS. Thus to encourage farmers to save their money in banks, rather than wasting it, a coordinated effort either institutionally or through the agricultural extension services is crucial. Formal rural banks and micro finance institutions should be established in major coffee growing areas. This can encourage saving culture and it also can help in reducing the spread of HIV/AIDS to some extent.

Currently, the Ministry of Health (MOH) in collaboration with UNICEF is distributing Long Lasting Insecticide Nets (LLINs) across the malaria-prone regions of the country (UNICEF, 2007). This is a very encouraging effort of the government to control the disease. However, the Government should ensure that supplies reach end-user points in correct quantities and at the right times, and people affected by malaria utilize them correctly. Collaboration with donors is also crucial because the success of the malaria control program also depends on the kind support of donors who provide the necessary supplies.

A study conducted in Kenya showed that reducing the incidence of malaria in each community to less than 10% will reduce vulnerability to consumption loss by 20% (Christiaensen and subbarao, 2001).

5.2. Capacity Building of Institutions

In addition to technical research and extension, policy should give attention to building the capacity of institutions such as coffee farmer's cooperatives, iddirs, iqqubs and work groups.

Coffee cooperatives and unions play important role in coffee marketing, supporting coffee farmers to manage risk, and policy advocacy/lobbying work on behalf of smallholders. However, they have a serious shortage of funds to purchase coffee and accomplish their marketing and coordination tasks. Usually they finance their transactions using credit from banks. In times when they are unable to repay the credit, they are not granted new loan. Thus some cooperatives do not buy coffee in some years because of their failure to repay the banks. Thus financial constraint limits the amount of coffee purchased. To address this problem, the USAID Development Credit Authority (DCA) is helping the cooperatives by financing the fund to purchase coffee without the need for collateral (Dorsey and Tesfaye, 2005). However, its sustainability still requires the commitment of the concerned parties and the close follow-up of the Ethiopian government.

Another crucial problem of cooperatives is the difficulty of market acquisition in the limited size of fair-trade market and the strict certification conditionalities of the fair-trade labeling organization (FLO). The number of FLO cooperatives in Ethiopia are still few (only 24 out of the 165 primary cooperatives as of May 2006) (Kodama, 2007). The main reasons for this include the general lack of administrative ability of the candidate cooperatives themselves, as well as the FLO's unwillingness to issue too many certificates due to the limited market for fair-trade products (ibid).

Thus cooperatives require capacity building programs that strengthen their administrative and accounting skills, provision of business and marketing information and better access to credit facilities. There is also a need for increased policy lobbying and advocacy work in the international market. Strong negotiations with concerned international coffee organizations such as ICO, FLO, and starbucks is required to improve the benefits of the smallholder Ethiopian coffee farmers.

In addition to coffee marketing and policy advocacy/lobbying work, coffee cooperatives and unions can play important role in managing risk. For instance, if cooperatives decrease the dividend they distribute to members and save the money in banks, and if the government provide them some financial assistance, then cooperatives can provide crop insurance to coffee farmers. In this regard, the collaboration of formal insurance institutions is crucial in insuring the insurer (i.e. reinsuring the cooperatives). Farmers in the study areas were eager to have such crop insurance schemes. For instance, 76% of the farmers in West Hararghe, 77% in Sidamo and 83% in Wolayta zones were willing to pay for crop insurance.

Beyond the usual traditional services that indigenous institutions (such as iddir) provide, it is possible to scale-up their role in managing risk. For instance, if iddirs collaborate with micro finance institutions, it is possible to provide credit to farmers who face a shock. If iddirs become financially strong by pooling resources from the community and through the assistance of the government, they can even become source of fund for investment.

However, they lack both technical and financial capacity to undertake such activities. Hence they require support in strengthening their administrative and management skills, accounting skills, and provision of credit for investment. The intervention of formal institutions such as insurance companies, micro-finances, and rural banks can make resources available to such indigenous institutions and increase the capacity of self-insurance. For instance, if a micro-finance institution is established in a given coffee-growing zone, the iddirs will get a safe place to save the money collected from iddir members, and the iddir members even can borrow from the micro-finance to solve their cash constraints.

Capacity building and empowerment programs should focus on improving the responsiveness and accountability in service delivery, poverty alleviation and enhance the effective participation of the rural poor in such local institutions.

5.3. Implications of the Regional Variation in Supply Response

The supply response variation across the study areas implies that there is no one-size-fits-all policy package, which can work for all zones in the required manner. Agricultural extension packages should take into account the agro-ecological, biophysical and socio-economic differences among coffee growing zones of the country. For example, applying same chemical fertilizer both in Sidamo and West Hararghe may not give the same result due to the difference in soil type in these zones. To bring about a meaningful change in the coffee sub sector, the policies formulated by the government or the interventions made by non-government organizations (NGOs), should take into consideration the socio-economic and agro-ecological conditions of a specific coffee growing area. It is crucial to investigate the living condition of that community, their major problems, their resource constraints, the main sources of shocks and how they respond to them, and what support they need. Designing intervention packages without incorporating such information will be wastage of scarce resources and the effect will end up being in vain.

Coffee means much to the Ethiopian economy both in terms of employment creation and export earning. Thus it requires much attention to perk up the productivity of Ethiopian coffee farmers.

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Declaration

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university. All sources of materials used for this thesis have been duly acknowledged.

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