ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

THE ROLE OF EDUCATION IN ENHANCING AGRICULTURAL PRODUCTIVITY:

THE CASE OF TEFF PRODUCTION IN SELECTED VILLAGES OF ETHIOPIA.

A thesis presented to the School of Graduate Studies Addis Ababa University in Partial Fulfillment of the requirements for the degree of Masters of Science in Economics (Economic Policy Analysis)

BY

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JUNE 2001

Addis Ababa University
School of Graduate Studies

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ACKNOWLEDGMENT

My most sincere thanks go to Dr. Workneh Negatu , my advisor, for his professional and technical guidance. Had it not been for his meticulous observation the successful completion of this paper could have been in doubt.

I would like to take this opportunity to express my special, heartfelt and invaluable appreciation to my brother Seyoum Negatu who financed not only my university education but also my special life as whole.

I am also grateful to Selamawit Kifle and Bizunesh Wondimu for the enormous task of typing the manuscript.

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ABBREVIATIONS

AREDU	Arssi Regional Development Unit
CADU	Chilalo Agricultural Development Unit
ERHS	Ethiopian Rural Household Survey
FAO	Food and Agricultural Organization
IDA	International Development Agency
MEDaC	Ministry of Economic Development and corporation
MOA	Ministry of Agriculture
MOE	Ministry of Education
NBE	National Bank of Ethiopia
USAID	United State Agricultural and Industrial Development
UNESCO	United Nation Education, Scientific, and Cultural Organization
WADU	Wollamo Agricultural development Unit
WB	World Bank
WOALP	World oriented Adult Literacy Program

ABSTRACT

Both formal and non-formal have been shown to provide benefit by increasing agricultural production. Data drawn from a large household survey conducted in1994 were used to estimate benefits of schooling in cereals production, particularly in teff production. This paper investigates the role of education in estimating agricultural production. We find that education (both formal and non- formal) are important to increase productivity of farmers by enhancing the capacity to acquire knowledge about the production process from other sources, should raise the individual producer's surface of production possibilities. However, the impact of both formal and non- formal education is stronger in rural areas where access of road is higher than areas where those accesses are poor. In addition to that, a threshold effect is identified: Some schooling (or at least 3 years of primary schooling) is required to have a significant effect upon farm productivity on traditional environment (areas where access to road and market facilities are poor). But the higher the access to those facilities, the larger level of education required obtaining an impact on productivity.

CHAPTER ONE

INTRODUCTION

1.1 Background

It has been said over and over again that agriculture is a fundamental and one of the main strategies for development for most less developing countries in general and Africa in particular. Sub-Saharan Africa depends on agriculture for economic growth and the well – being of its people. The activities of this sector have existed for thousands of years; ever since human kind gave up hunting and gathering as its main source of food .As the main source of rural livelihoods, agriculture remains the principal occupation of the majority people in Africa .On average 35 percent of GDP; 70 percent of employment, and 40 percent of export are contributed by the agricultural sector (World Bank, 1997).

To speak differently, agriculture is the major source of raw materials for industries, is the main purchaser of simple tools (farm implements), and services (farm machines, transport), and farmers are the major consumers of goods since they constitute the majority of the population.

Despite the importance of agriculture to Africa, it has remained below its potential and even backward relative of Asia and Latin America. During the 1980-1990, the agricultural growth rate for Africa declined slightly to 1.4 percent per annum, while the population growth rate expanded to 3.1 per annum in the same period (World Bank, 1993). One can say that basic food production in many African countries could not keep pace with the rapid growth of population; agricultural exports have declined in most instances; the area has suffered, and is still suffering, from widespread adverse weather conditions and sever depletion of reserves of potentially productive agricultural land.

The overall performance of the economy is highly correlated to the performance of agriculture sector. Information from Ministry of Economic Development and Corporation (MEDaC) (1998) indicated that the average growth rate in agriculture during the Derg period was a mere 2% which was significantly lower than the rate of growth of population. The food deficit in the country increased during this period. Agricultural production under this government did not show a significant improvement. Similarly the average rate of this sector was 2.27% per annum between 1992 and 1998 (National Bank of Ethiopia, 1999). In any case, the rate of growth is much lower than the population growth. The scope of increasing food production through expanding the size of cropland, as was the case before, has become drastically narrowed. In most part of the country, horizontal expansion of local food production to keep pace with the population growth is becoming increasingly difficult.

A number of reasons can explain the poor performance of agriculture in developing countries. It is not necessary to catalog here all the factors. But as low level of productivity is one of the main constraints of this sector, it is enough to remember, and to keep bringing to the attention of policy-makers, that achieving an increase in agricultural productivity is a complex business; hence, to obtain maximum results, a range of factors, many of them interdependent, must be in place and in harmony.

One of these factors is low level of education in rural areas -the means for developing and conveying essential information required by farmers to increase their labor productivity and the productivity of their land. Poorly educated people in rural areas whose number is expanding at a higher rate can not read and write nor communicate to develop their mind and hence, may not be able to transform the backward system of traditional agriculture in most of African countries. Africa is the only region where primary enrolment rates were lower in 1995 than in 1980. Fore example, in 1980s general primary enrolment rate was 79% but in 1990s it was 75% (see table 1.1).

Table 1.1: Gross Enrollment Rates in Africa, 1960-1997 (in percentage).

Level in total	1960	1970	1980	1990	1997
Primary	43.3	52.5	79.5	74.8	78.8
Secondary	3.1	7.1	17.5	22.4	26.8
Tertiary	0.2	0.8	1.7	3.0	3.9

Source; UNESCO, statistical yearbook, 1978-79 and 1998

1.2 Research problem

Education has played a positive role in the development of society by promoting a range of activities and innovation. Investing in people's education boosts the living standards of households by raising productivity, expanding employment opportunities, attracting capital inflow and enhancing earning power.

The Ethiopian system of education has a long way to go to play a quite relevant and dynamic role in the process of economic development. Despite the expansion of education in Ethiopia, the parallel growth of population has hindered significant reduction of adult illiteracy, which is estimated to be 77% for females and 55% for males in 1995 (World Bank, 1996). Gross enrollment ratios are still very low even by Sub-Saharan Africa standards. It was estimated at 34.6% for grades 1 to 6; and 30% for grades 7-8 are considered .In addition to that there is wide disparity between urban and rural areas. The total primary gross enrolment ratio was 91% in urban areas and only 18% in rural areas (MOE, 1996). This shows that there are a number of school age children in rural Ethiopia still lacking the opportunity for education. In fact it is recorded that enrolment in absolute terms, has significantly increased. However, a large proportion of the school age population is outside the school system, that is, rural areas are not well served. Therefore, the need for the expansion of the coverage and quality of education has still remained to be a major challenge.

When we see the performance of the agricultural sector in Ethiopia, the value-added grew only by 3.8 percent in 1998/99 from a negative base in 1997/98 in which the value-added fell by 10.8 percent. It is, therefore, apparent that the growth rate in value-added in the sector in this fiscal year did not recover even half of the fall in the preceding year. This low performance of this sector is a direct reflection of the poor performance in the crop production. As a result, the production of major crops during the last eight years was not sound. A major boom was recorded in 1995/96 when cereal and major crops production grew by 58.4 percent and 51.1 percent, respectively. This rate was not sustained the following year as a major shock in 1997/98 when cereal production and major crops production fell by 23 and 21.8 percent, respectively. The 6.4 percent rise in major crops in 1998/99 was not enough to fully recover the fall in the previous year (National Bank of Ethiopia, 1999).

When we see the share of cereal crops to the total production; teff production covered 23 percent of the total cereal production as observed between 1981 and 1997. On average, about 1.5 million-hectare was cultivated for teff production for the period 1980/81 to 1996/97. That is, the share of teff in the total area was 31 percent on average. But, the yield of teff did not show any significant increase between 1980/81 and 1996/97. On average teff yield was 8.9 quintals per hectare while that of barley and wheat were 11.9 and 12.21 quintal per hectare, respectively. Thus, the yield of teff was 26 to 28 percent lower than that of barely and wheat. Therefore, even though teff accounts for the highest share in the total fertilizer consumed by the peasant sector (i.e. it took 45.2% of total fertilizer applied in the peasant sector or 49.3% of the fertilizer applied on cereals in 1996/97.), no significant change in productivity or yield was recorded in the past (FAO, 1998).

Therefore, one can say that the contribution of education and extension service in promoting productivity of small-scale resource-poor farmers has been very low. These and other figures hence show how serious the problem is and how serious the challenge is ahead in agriculture productivity in general and education development in particular. Therefore, if education plays any significant role, it has to be reflected in the agricultural sector where nearly half of the

GDP is organized, more than 90% of the export revenue is generated, and more than 80% of the employment opportunity is created.

1.3 Objective of the Study

The overall objective of the study is to empirically determine the effect of education on agricultural productivity and examine the importance of education in this sector.

Specifically the study intends to:

a) Assess the trends and identified major constraints of productivity in smallholder farming.

b) Explore farmers' access to formal and non-formal education.

c) Examine the role of formal and non-formal education in agriculture productivity.

1.4 Significance of the study

It is believed that more educated farmer is supposed to make the required adjustment more quickly. Therefore, in a country like Ethiopia where agricultural intensification is given top priority in the country's development strategy, such study that deals with the role of education and agricultural productivity is quite relevant and appropriate to increase agricultural output.

To be specific, much has not been done to assess the role of education on agricultural productivity. Therefore, studies related to education and productivity is important mainly because of the following reasons:

(1) Even if, on average 12% of the total government annual expenditure was allocated to the educational sector during the last decades, its contribution to the agricultural sector is weak

(Assefa and Abay 1998). Therefore, in a situation where agriculture is the backbone of the economy, it is really imperative to assess the role of education on agricultural productivity.

2) Moreover, the study is expected to contribute to the existing literature in the field and it may give recommendation relevant for policy makers.

1.5 Scope of Research

This study focuses on the role of education in enhancing agricultural productivity. Since farming takes a higher share of agricultural activities in most rural areas, focus is on farm productivity. This thesis is limited to see the impact of education on teff production due to a number of reasons. First, teff is generally considered as the most important cereal crop in Ethiopia. Second, it covers a large part of cultivated land (3% of the total land allocated to cereals). Third, teff accounts for the highest share of the total fertilizer bought by farmers. For example, it absorbed 45.5% of the total fertilizer applied in the peasant sector in 1996/97 (FAO, 1998). And fourth, studies on teff production are limited relative to other cereal crops.

The study will focus on both traditional areas (areas where the system of farming is traditional in terms of technology and input use) and modern areas (where the system of farming is relatively modern in terms of technology and input use). That is, traditional agriculture of the area is often described as subsistence rain fed agriculture combined with limited amount of fertilizer and high-yield varieties while in modern areas there is irrigated agriculture with high consumption of fertilizer and high-yield varieties.

Since the study is at a micro level, it is limited to four Woredas from both areas. The Woredas have different agro-ecological zones. Therefore, it is believed that by drawing samples from the different agro-climatic zones in the Woredas, the study would appreciate some sort of heterogeneity among farmers.

Even if education has different effects (i.e. work effect, allocative effect and external effect) up on agricultural output, this study focuses on work effect of schooling (which refers to the increase in farm output that is owing directly to education, holding other input constant) due to the following two possible reasons: (a) In measuring the allocative effect of schooling (which refers to the benefits that education may confer in terms of an increased ability to read instructions and calculate treatment amount for new inputs) , the dependant variable must be total farm output aggregated over at least two crops. But in this study we have only one type of crop, which is teff. (b) one way of capturing the external effect of schooling upon production is to estimate an aggregate village-level production function. However, since the ERHS data are drawn from a small number of villages, there are few degrees of freedom and the result would not be highly robust.

1.6 Organization of the study

The thesis is organized as follows. Chapter 1 includes the introduction, research problem, objective, significance of the study, and scope of the research. Chapters 2 will cover farmers' access to formal and non-formal education in Ethiopia. In addition to that, this chapter includes the trends and constraints of productivity in smallholder farming. Chapter 3 reviews the literature about the role of education in agricultural productivity. Chapter 4 covers research methodology and Chapter 5 present's data analysis and discussion of the results.

Finally, in chapter 6, summery of the main findings, conclusions and recommendations are presented.

CHAPTER TWO

FARMERS' ACCESS TO EDUCATION, AND CONSTRAINTS OF FARM PRODUCTIVITY IN SMALL HOLDR FARMING

2.1 Farmers access to formal and non-formal education in Ethiopia.

2.1.1 Access to formal education

Basically, the development of Ethiopian education system was deeply rooted in religious education of which the two mainstreams were Christianity and Islam. Though education has a very long history in Ethiopia, modern public education made a modest entry into the history of the country at the beginning of the 20th century with the establishment of Minilik School in 1908 (Tefera, 1996). Modern education creeped into the country and was designed to serve the interest of the ruling class of that time. It was after the Second World War that a system of modern education began to develop in this country under the leader ship of Emperor Haile Selassie I.

Ethiopian education system has two main sub-sectors that are institutionally separate; (1) the formal education sub sector, which consists of academic and technical training at primary, secondary, and tertiary level; and (2) non-formal education, which includes technical vocational skills training and extension contact for the youth and adults. Between 1962 and 1994, general education was divided into three levels: primary school (grades 1 - 6); junior secondary school (grade 7-8); and senior secondary school (9-12). Education reforms in 1994 revised the structure so that it now consists of primary education (grade 1-8), where grades 1-4 aim at achieving functional literacy and grades 5-8 prepare students for further education; general secondary education (grades 9-10), which enables students to identify area of interest for further education and training; and a second layer of secondary education (grades 11-12) that prepares students for higher education.

In Ethiopia primary school attendance is characterized by poor participation rate in the past two regimes. The highest recorded primary gross enrollment ratio (GER)[1] for Ethiopia was 38 percent in 1986, only slightly more than half that of sub-Saharan Africa overall. This is due to the very low enrollment rates in rural areas. Nearly universal primary education has been achieved in urban centers. Low enrollment in the rural areas is therefore mainly responsible for the low national average (World Bank, 1994).

A primary school enrollment has declined continuously. In absolute terms it declined from a level of 2.9 million in 1987/88 to 1.9 million in 1992/93 (World Bank, 1996). On the other hand; 1995 estimates by MOE indicates that primary GER has increased to 34.6 percent for grade 1-6 and 30.1 percent for grades 1-8. Similarly GER for secondary and tertiary school was very low. In 1995 it was 19 percent for junior secondary and 9 percent for senior secondary). According to the MOE, only 1 out of10 children who enter primary schools completes the 12th year of secondary school in 1996. Access to secondary education in rural areas is very low compared to primary education. For example, in 1995 GER was 6 percent in junior secondary schools in rural areas, compared to 73 percent in urban areas (MOE 1996).

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1 The gross enrollment ratio is calculated as the ratio of currently enrolled students (regardless of their age) to the total eligible population in the relevant age group.

According to the MOE records, less than one-half of 1 percent of the school age population in Ethiopia is able to gain access to tertiary education in 1995.

As mentioned above, enrollment ratios indicate wide disparities between urban and rural areas. The total primary GER was 91 percent in urban areas and only 18 percent in rural areas. On average, children in rural areas enter grade 1 at a later age (at least 11 years) compared with children in urban areas (9 years). Similarly the junior and senior secondary GER were 24 percent and 23 percent in urban areas and both were 1 percent in rural areas, respectively. The following table shows the net enrollment ratios by schooling and urban/rural.

Table 2.1: GER by Schooling Level and Urban/Rural in 1995.

Urban/ Rural	Primary	Junior Secondary	Senior Secondary	Tertiary
Urban	0.90	0.24	0.23	0.01
Rural	0.18	0.01	0.01	-

Source: Ministry of Education, 1996

Management Problem, provision and financing of education contribute to the poor access of rural people to formal education in Ethiopia. On the other hand, even if the supply of schooling increased in absolute terms for the last seven years, high rate of population growth and low demand of schooling (due to opportunity cost of children's time in school) were other problems of schooling in manys part of rural Ethiopia.

2.1.2 Farmers' access to Non- formal education

Descriptions of Non-Formal Education (NFE) activities in the rural sector might have been based on the type of non-formal educational techniques being utilized, as well as the basis for descriptions of NFE in the modern sector. However, it was felt that classification by the objectives of the programs in the rural sector provides the more meaningful basis for taxonomy (Niehof and Wilder, 1974). Accordingly, the programs that were investigated in the rural sector of Ethiopia were classified by the type of program and the objectives of the organization conducting the NFE activity. The first groups of non-formal programs described were Agricultural Development and Agricultural – Based Multipurpose Programs. It is understood that there were more than one non-formal educational technique employed in this classification. The second group was concentrated on public health. Here also more than one technique or method of non-formal education were utilized, and some duplicate those used in the programs with an agricultural development orientation. The third group was concerned with programs engaged in training personnel to conduct rural development programs.

In Ethiopia, the ' Extension Package program' concept refers to development programs that are based on the introduction of related groups or 'package' of inputs or innovations. In rural areas, the package was based on the agricultural inputs necessary for the farmer to increase production. The number of inputs included varies from program to program, and the inputs may also contain other components, such as women's programs, literacy training, etc.

The Chilalo Agricultural Development Unit (CADU, 1967-74) was one of the earliest examples of large-scale package programs in Ethiopia and it was a joint project of ministry of Agricultural and Swedish international Development Agency [Nekby 1971]. The educational /development program of CADU was composed of four principal elements: (1) the model farmer, (2) agricultural extension and marketing agents, (3) experimentation and research to feed ideas to the educational processes, and (4) agricultural services such as credit, marketing, and other services to provide essential substantive ingredients to the educational processes. [Bergman 1970, Tecle 1975, Gebregziabher 1975].

The CADU 'package' was the most comprehensive package in Ethiopia. The program's major emphasis was on increasing agricultural production; however, it also contained extensive women's programs, including home skills, and literacy programs.

The CADU 'package' demonstrated the value of a package approach to agricultural improvement and the participants had greatly increased their agricultural yield (including the production of milk) and their income. The principal particles espoused, including the use of better seeds, increased use of fertilizers and other improved practices, had been widely replicated. Innovations were created in agricultural machinery. Improved methods of providing credit a securing repayment of loans were demonstrated. A plan for initial and continued research was included in the program's strategies and operations. Effective non-formal education methods were devised to strengthen the participation of men and women, largely illiterate, in the developmental process, thus improving their own welfare and increasing their contribution to national goals. (Hunter and others 1974).

Wollamo Agriculture Development Unit (WADU) initiated two years after CADU, was the second major agricultural package program initiative in Ethiopia and was funded by a loan from the International Development Agency (IDA). CADU was a comprehensive package program has included the full range of inputs needed for agricultural development: extension, cultivation techniques, seeds, fertilizer; credit, marketing, women's programs, roads, research, crop trials, and so forth. WADU, had no research program, no farm implementation and manufacturing component, non women's program, and non water development program (Tecle 1975].

Generally stated, the overall objective of the program was to increase agricultural production, both in terms of quantity and quality of the crops and animals raised. Non-formal education techniques were used in the program to facilitate the adoption of new agricultural practices and inputs, in this case principally improved seeds and fertilizers. Two very interesting non-formal education activities, which were being conducted in the same area as the WADU project, were the UNESCO Work Oriented Adult Literacy Program (WOALP) and the Agri-service Ethiopia program. The work aspect of the UNESCO literacy program was centered at agriculture, women's program and handicrafts mainly weaving. The Agri-service Ethiopia program was centered at the areas of the country where agricultural extension agents were working (Niehoff and Wilder, 1974).

The UNESCO/WOALP program was fairly extensive, with enrollment in the WADU area in the first few months of 1972 being reported as approximately 6,800 students. This figure was large in comparison of the total number of farmers in the area. But all the enrollees were not active farmers. Many were women, older men who were not necessarily heads of households, and many children who were not able to enter the regular school system. The non-formal education techniques utilized focused largely on demonstrations and were based on techniques proven by other developmental projects in Ethiopia.

After the Ethiopian revolution and the agrarian reform of 1975, the CADU approach was extended to cover the whole Arssi region, and the Arssi Regional Development Unit (ARDU) was created. ARDU spent most of its extension time and resources in helping farmers who belonged to producers' cooperatives in which land was cultivated communally, and extension agents did not extend their services to small private farmers.

The extension services in other regions of Ethiopia have considerably fewer resources. Each of the specialized departments of the ministry of agriculture (water and soil conservation, livestock, plant husbandry, agronomy, and cooperative development) runs its own extension service that reaches down to the sub district level. Contact between extension agents and a farmer in other regions was even more limited than in Arssi, where the ratio of extension agents to rural households was roughly 1:1,900. In some areas, which were fairly similar in potential to Arssi, for example, the ratio was 1:6,000 (ARDU, 1976).

The training and visit (T & V) extension system was introduced in June 1983 as a pilot project in the Tiyo and Hetosa sub districts of Arssi region, Ada and Lume sub districts of Shoa region, in the Shashemene and Arssi-Negelle sub districts in the southern part of shoa. The T&V system was characterized by a systematic time bound program of staff training and farm visits. Discipline, a concentration of staff effort on agricultural problems, deliberate linkages with researchers was assumed to assist in improving the effectiveness of extension services. The training and visit pilot project was based on the assumption that the effective communication of relevant message was crucial for adoption of a new technology. As indicated by Bener (1984) the basic features in its design includes: a) a regular schedule of visit by extension agents, involving person-to-person contact with farmers, so that production recommendations can be communicated effectively; (b) Regular training of extension agents to up grade their skills, (c) its attempt to link extension and research.

After the fail of the socialist government the National agricultural extension package program has been launched since 1994/95. The programmed assists small-scale farmers to improve their productivity through dissemination of research-generated information and technologies. The program, which was only limited to 7 regions and 35,000 farmers in the initial year, has expanded to all regions and participant of 3.5 million farmers in 2000-production season (Table 2.2).

Table 2.2: Farmers Participation in the Extension System

Year	No. Of regions	No. Of farmers
1994/95	7	36600
1995/96	11	350000
1996/97	11	650000
1997/98	11	2909244
2000	11	3508112

Source; Ministry of Agriculture, 1999/2000

The extension program has demonstrated to farmers the possibility of increasing production and productivity of crop and livestock, which in turn increased demand for agricultural services. The extension program has enabled the participation to increase their production per hectare. However, even if extension program is expanded in different regions of the country, the production of major crops is still low. Fore example, in 19997/98, cereal production and major crops production fell by 23 and 21.8 percent, respectively (National Bank of Ethiopia, 1999).

2.2 Trends and constraints of farm productivity in Ethiopia

Ethiopia has a total land area of about 113,000,000 hectares. Some estimates suggest that about 12.6 million hectares, 10.3% of the total area is intensively cultivated, and 15.3 million-hectare (12.5%) is moderately cultivated while other proportion of the land area is covered by forest and grassland (Ministry of Agriculture, 1998).

Table 2.3: Area Cultivated ,Total Production and Yield of Cereals, Pulses and Oil Seeds.

	Cereals			Pulses			Oil Seeds		
Year	Quintals ('000)	Area (000'ha.)	Yield (qt/ha.)	Quintals ('000)	Area (000'ha)	Yield (qt/ha)	Quintals ('000)	Area (000'ha.)	Yield (Qt/h
1980	56118.61	4711.85	11.91	9494.09	867.71	10.59	641.27	123.55	5.19
1981	54071.71	4625.77	11.68	9143.22	902.77	10.12	503.4	151.31	3.32
1982	67182.8	5029.22	13.35	10272.7	936.04	10.97	789.3	172.6	4.57
1983	55268.19	4715.59	11.72	7987.28	867.81	9.204	589.3	154.71	
1984	42398.47	4814.68	8.806	6012.39	862.5	6.971	618.2	181.13	3.41
1985	48199.87	4991.57	9.656	5389.27	858.96	6.274	595.42	167.17	3.56
1986	65040	5304.86	12.26	6470.14	791.87	8.171	476.54	139.58	3.41
1987	61950	5237	11.82	6109.42	871.81	7.008	440	116.3	3.78
1988	63840	5300	12.04	6111.37	854.24	7.154	423.52	115.45	3.66
1989	63550	5180	12.26	6242.69	753.99	8.28	407.72	129.54	3.14
1990	64a570	5060	12.76	7108.43	808.34	8.794	423.94	132.49	3.2
1991	63050	51120	12.31	8244.55	939	8.78	600	159	3.77
1992	70700	5265	13.42	8150	925	8.811	600	159	3.77
1993	69060	5217	13.23	8723	978	8.915	570	144	3.95
1994	72760	5023	14.48	9550	1078	8.859	560	144	3.88
1995	91670	6737	13.60	11130	1247	8.925	570	145	3.93
1996	110600	8771	12.61	1138	1276	0.892	580	146	3.97
Average	65883.27	5399.48	12.23	7361.40	934.48	8.16	546.7	147.33	3.79

Source; Central Statistical [2]Authority, 1998/99.

2 One ton is equal to 10 quintals.

As shown in table 2.3, cereal production averages 6.6 million tons during the period under consideration. On the average, 5.4 million hectare of land was cultivated to grow cereals, giving a yield level of 12.2 quintals or 1.2 tons per hectare[2]. On the other hand on average annual pulse production amounted to 807,168 tons, compared to 55,226 tons in the case of oilseeds. On average 930,560 and 145,930 hectares of land was allocated of the production of pulses and oilseeds respectively. Therefore, yield levels were low, averaging 8.7quintals to pulses and 3.8 for oilseeds (Table 2.3 above).

Therefore, for the period 1980 to 1996, cereals are by far the most among the field crops, accounting for 88.3% and 83.2%of the total production and cultivate, respectively. But the share of pulses and oil seeds was 10.9 and 0.8% in the total production and 14.5% and 2.3% in the total area cultivated (Table 2.3 above with own calculation).

From this information one can say that the share of cereals increased over time and farmers seem to allocate a large proportion of their land to the stable cereal crop mainly due to decline in farm size. When we see the performance of major food crops, the highest yield is reported for maize and the lowest is for teff while barley and wheat varied between the two.

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Table 2.4: Nation Wide Total production of Five Major Crops

YEARS	Quint. ('000)	Area (000'ha)	Yield (Qt/ha)	Quin. ('000)	Area (000'ha)	Yield (Qt/ha)	Area (000' ha)	Yield (Qt/ha	Quintals ('000)	Quint ('000)	Area (000'ha)	Yield (Qt/ha)	Quin. ('000)	Area (000'ha)	Yield (Qt/ha)
1980/81	13337.06	1385.10	9.63	8304.76	671.15	12.37	973.35	12.27	14194.17	9810.54	743.21	13.20	5105.56	462.27	11.05
1981/82	11018.78	1354.43	8.14	10437.24	582.95	17.90	831.50	17.90	12165.04	8677.27	727.8	11.92	5140.94	592.09	10.03
1982/83	13971.54	1423.52	9.82	14583.63	7732.97	19.90	897.14	19.90	13786.95	10706.3	814.68	13.14	7993.91	632.49	12.64
1983/84	11258.11	1360.46	8.26	14796.31	799.09	18.52	929.96	18.52	12298.144	8341.17	816.71	10.21	6036.42	580.25	10.40
1984/85	9057.14	1339.88	6.76	9598.82	847.72	11.32	754.46	11.32	5058.10	7721.94	741.41	10.42	5850.42	592.10	9.90
1985/86	9575.64	1291.89	7.41	8825.75	784.25	11.25	843.45	11.25	9005.50	8070.45	821.42	9.83	6571.58	686.11	9.58
1986/87	10331.10	1277.08	8.09	15411.03	932.10	16.53	752.85	16.53	9670.38	8938.71	797.96	11.20	6511.21	587.31	11.09
1987/88	10180.10	1246.62	8.17	16309.65	856.35	19.05	773.36	19.04	8914.94	8220.75	676.54	12.15	6817.89	592.63	11.50
1988/89	12087.47	1367.68	8.84	14550.75	788.81	18.44	607.51	18.45	8423.41	7415.36	648.81	11.43	6884.10	561.35	12.26
1989/90	10475.01	1219.33	8.60	17243.37	880.27	19.59	723.18	19.59	9646.94	8099.25	588.93	13.75	6936.53	540.03	12.85
1990/91	18405.54	1287.91	14.29	11821.13	926.84	12.75	498.83	12.75	6840.27	7256.07	561.67	12.92	7135.28	497.15	14.35
1991/92	11985.18	1378.17	8.70	12591.66	766.13	16.44	429.70	16.43	5588.62	7582.60	605.27	12.53	7595.57	549.23	13.83
1992/93	14007.17	1395.79	10.07	14347.71	775.90	18.53	435.17	18.53	6456.87	8090.56	612.98	13.12	8860.35	556.23	15.93
1993/94	12960.23	1431.43	9.04	13820.30	835.60	16.54	458.55	16.54	7246.08	9000.74	594.08	15.15	7885.10	573.83	13.74
1994/95	13542.20	1923.04	7.04	17451.50	1152.20	15.15	924.11	15.15	11701.55	8841.36	916.97	9.64	10679.4	802.42	13.31
1995/96	17523.75	2097.40	8.36	25392.92	1280.69	19.8	1252.4	19.83	17226.52	8725.75	825.54	10.57	10763.4	882.06	12.20
1996/97	20018.93	2167.77	9.24	25320.03	1316.87	19.23	1399.9	19.23	20073.46	7423.85	697.67	10.64	10015.9	772.23	12.97
Average	12925.59	1467.50	8.85	14754.91	878.23	16.67	793.27	16.67	10488.01	8407.22	717.16	11.88	7504.90	615.28	12.21
	Teff			Majz					Sorghum	Barley			Wheat		

Source: CSA, 1999.

Between 1980/81 and 1996/97, annual teff production was 13 million quintals, with a growth rate of 1.9% per annum. The recovery of output after 1991/92 was very strong except in 1993/94. Teff production increased (over the previous year) by 29% in 1995/96 and 14% in 1996/97 (Table 2.4). From the total cereal production 23 percent is made up of teff, but the dominance of this production is true if we consider the area cultivated. On average, about 1.5 million-hectare was cultivated for teff production for the period 1980/81 to 1996/97. That is the share of teff in the total area was 31 percent on average.

However, the yield of teff did not show any significant increase between 1980/81 and 1996/97. On average, teff yield was 8.9 quintals per hectare while that of barley and wheat was 11.9 and 12.21 quintals per hectare, respectively. Thus, yield of teff was 26 to 28 percent lower than that of other cereals like barley or wheat. Even though, teff accounts for the highest share in the total fertilizer consumed by the peasant sector (i.e. it took 45.2% of total fertilizer applied in the peasant sector or 49.3% of the fertilizer applied on cereals in 1996/97.), no significant change in productivity or yield was recorded in the past.

A number of explanations can be given for the poor performance of agricultural productivity in general and teff production in particular; the key constraints include the following:

-The technology base of peasant agriculture is very poor over the years. The prevalence of an age-old backward traditional farming system forced productivity level in peasant farms to remain very low.

-Lack of access to modern inputs is one of the constraints. For instance, one of the problems of teff production is limited use of improved seed; on average only 1.7 percent of teff area was covered with the improved seeds in 1996/97 (FAO, 1998). As a result fertilizer is often applied mainly with local seed.

-A major factor behind the low and stagnating yield is dependent on rainfall agriculture system. Irrigated cereal production covered only 0.6% of the total area. Similarly, from the total teff production only 0.2 percent was covered by irrigation (CSA, 1997). Such poor access to irrigation has made the use of improved seeds and other technologies very risky and less profitable.

-Agricultural research and extension: agricultural research is in an organized quest for new knowledge; on the basis of scientific method it seeks to confirm or refine what is known, to improve method and technologies, equipment, and practices. Despite research importance to agriculture it has remained low in this country due to lack of adequate resources. For the period 1996 to 1997 average expenditure was only about 15 million Birr although it has shown an increasing trend over time. For example, in 1993/94 expenditure on agriculture research in Ethiopia was 0.2% of the agriculture GDP (i.e. in 1994, investment in agricultural research amounted to Birr 26.59 million, while agricultural GDP for the same year (in nominal price) was roughly 14 billion). Thus, this amount was below the recommendation that the World Bank has called for a target of 2% of the agricultural GDP to be invested in agricultural research (National Bank of Ethiopia Quarterly Bulletin, 1998).

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CHAPTER THREE

LITERATURE REVIEW

3.1 Theoretical background

Education, in its different forms, is considered as one of the important aspects in human resource development. Most fundamentally, development requires change in the attitudes and action of individuals. Education can help people understand why change is necessary and can prepare them to acquire the knowledge necessary for achieving change. To increase agricultural productivity it is not sufficient; for example, that a farmer merely knows that fertilizer increases yield. Rather, he must have enough understanding on how to apply the proper kind and quantity of fertilizer in relation to the nature of the soil, rainfall or to the quantity of irrigated water at his/her disposal.

Three different types of education are often distinguished in the literature. "Formal", which consists mainly of schooling; "non-formal", which includes different kinds of extension and organized apprenticeships; and "informal", which refers to a wide definition of learning-by doing, including not only direct experience in a particular job but the multi-dimensional processes of learning that arise from being exposed to different circumstances (Coombs and Ahmed, 1974: Figueroa, 1986).

Education can have "cognitive" and "non-cognitive" effects. The cognitive effects consist of the development of general reasoning skills and the transmission of specific knowledge. The non-cognitive effects modify attitudes and beliefs[3]. In the cognitive area there exist strong interactions between developing a generalized capacity of thinking and learning, on the one hand, and the specific subjects learned, on the other (Figuerod, 1986).

It has been argued that the greater structure, longer duration and specific age group of school attendance makes formal education best suited for the "formation of competence", while the greater flexibility of non-formal services, which allow them to deliver a message closer to the work place, makes this type of education best suited for the "transmission of information". Informal education can provide either cognitive or non-cognitive effects depending on the specific type of experience. For example, a migration experience as an urban street seller may improve the numerical capabilities of a peasant, facilitating future calculations of costs and returns on the farm, whereas his experiences as a farm wage-laborer can put him in touch with specific information about new technologies that he can then apply to his own farm (Bowman, 1976; Jamison and Moock, 1984).

Many of the non-cognitive effects of education -receptivity to new ideas, competitiveness and willingness to accept discipline - are directly relevant to productive economic activity. Others - tolerance, self-confidence, social and civic responsibility - are more personal or political in nature (World Bank, 1980). Formal and informal education is likely to be the most important processes for the change of attitudes and beliefs.

3 The relative importance of these effects is still poorly understood: see, for instance, the debate between the "anthropological" and the "economic" views in Wharton.

What are the mechanisms through which education can have an effect on output and income? Education may have productive value because it enables the farmer to produce larger output quantities from the same quantities of inputs and because it helps the farmer to allocate resources in a cost-efficient manner, choose which and how much of each output to produce, and in what proportions to use inputs in their production (Jamison and Moock, 1984). Welch (1970) has labeled these effects of education as the "worker" effect and the "allocative" effect. The former is related to the enhanced capacity of production with a given set of inputs, and the latter has to do with the farmer's ability to acquire and decode information about costs and productive characteristics of other inputs. A central aspect of the allocative effect is the capacity to evaluate and adopt profitable new technologies.

Many variables must be taken into consideration when assessing the new technologies. Imposing order on the existing evidence and understanding the results is a difficult process, and here education may be expected to play an important role. Schooling can facilitate the process in several ways. Increased numerical skills are likely to be of importance. A greater capacity for abstraction will make it easier for an educated farmer to uncover causal relations between technology and outputs which-because of long lags between application and results and weather-related randomness influencing the results-may remain obscured to less educated farmers. Well-designed extension programs are also likely to help the farmer through this process by demonstrating technologies under conditions that are similar to the farmer's own, by pointing out the causality between the use of new inputs and specific results and by facilitating the calculations of profitability. Also crucial in this phase are the non-cognitive roles of education, which can make the farmer more receptive to new ideas and more selfconfident and, consequently, more willing to innovate.

Adoption as a process largely consists of the identification of "superior technologies". However, education itself can be a crucial complementary input in the new technological package. The superiority of the new technology over the traditionally used ones may require the presence of high levels of education. The productivity levels obtained with the new technology may crucially depend on the farmer's education (Eicher and Staatz, 1990).

The use of some modern technologies may involve a large number of alternative procedures, and the choice of a particular one may depend on the conditions of the natural environment or the market. When this is the case, recourse to memory may be insufficient and personalized transmission of information inefficient. In this situation, literacy may be needed to facilitate the storage of the large amounts of information involved and ease its impersonalized transmission. When chemical inputs are introduced, numeracy may be required to calculate the correct proportions in their use. All this suggests that there may exist high costs to learning the use of the new techniques, and these costs are likely to be smaller for the more educated farmers. The level of education required for the efficient use of inputs could depend on the sophistication of the new technologies. For the simpler ones, no formal education might be necessary, basic literacy might be enough. For the more complex technologies higher level of education will be necessary.

An implication of this is that when modern technologies are in use, education is likely to have a positive effect on productivity. Thus, education may favor adoption not only because of the confident and, consequently, more willing to innovate.

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An implication of this is that when modern technologies are in use, education is likely to have a positive effect on productivity. Thus, education may favor adoption not only because of the role it can play in the faster discovery and assessment of the new technologies but also because it acts as a complementary input for the appropriate use of the new technologies. Hence, adoption will be more profitable for the more educated peasants. In other words, a major reason for the early adoption of the more educated farmers may be that the gain in productivity that can be obtained from the new technologies is larger for them.

Increasing literacy may help farmers to acquire and understand information and to calculate appropriate input quantities in a modernized or rapidly changing environment. Improved attitudes, beliefs and habits may lead to greater willingness to accept risk, adopt innovations, save for investment and generally to embrace productive practices (Appleton and Balihuta 1996; Cotlear 1990). Education may either increase prior access to external sources of information or enhance the ability to acquire information through experience with new technology. That is, it may be a substitute for or a complement to farm experience in agricultural production. Schooling enables farmers to learn on the job more efficiently (Rosenzweig 1995).

Education may directly influence agricultural productivity via one or more of the routes described above. Education may also indirectly increase output through its interaction with other institutional variables. For example, schooling may substitute for access to credit by providing the skills necessary to obtain waged employment, thereby generating cash to finance agricultural investments (Appleton and Balihuta 1996). Collier and Lal (1986) note the importance of non-agricultural income for farm productivity. Remittances from migrants educated by the household may also serve this function. Furthermore, Phillips and Marble role it can play in the faster discovery and assessment of the new technologies but also because it acts as a complementary input for the appropriate use of the new technologies. Hence, adoption will be more profitable for the more educated peasants. In other words, a major reason for the early adoption of the more educated farmers may be that the gain in productivity that can be obtained from the new technologies is larger for them.

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(1986) note that educated farmers are able to interact more effectively with crec because they can understand financial transactions and keep records, increasing the . of obtaining credit.

The main hypothesis derived from the preceding discussion is straightforward. Education helps people to obtain and evaluate information about improved techniques and new economic opportunities to keep track of past events and estimate the returns to potential innovations. Education also helps people to use the new techniques adequately, with a lower learning-cost. In consequence, we expect to observe education to be associated with higher productivity.

3.2 Empirical studies

Several studies have attempted to test the above hypothesis. Lockheed, Jamison and Lau (1980) reviewed studies from 37 regions, which tested the effects of farmer's schooling on agricultural productivity. Most of these studies used production function and output was regressed against physical inputs and education indicators. In their analysis they concluded that four years of school education was associated with a mean increase of 9.5% in agricultural productivity in areas where a significant change in agriculture was taking place. In contrast, in agricultural areas where little change was taking place, an average of only 1.3-% gain in agricultural productivity was attributable to four years of schooling. Another study by Lockheed, Jamison and Lau (1980) review of eighteen studies of farmers`education conclude that four years of elementary education increased farm productivity by an average of

7%; with some evidence of a threshold number of years of schooling (four to six), at which the effect of education was greater.

It suggests that education is practically likely to increase the output of traditional farmers if other complementary attempts are made to change the farming environment –by the provision of roads or of access to marketing facilities, fertilizer, better crop varieties and so on. Evidence suggests that four years schooling is capable of enhancing the output of modernizing farmers by as much as 10% per year, as compared to uneducated farmers in the same area, keeping land, capital and labor time constant. Although these results are promising, it has to be noted that in most of the studies surveyed the education variable was measured very simply by years of schooling. Thus, some of the apparent increase in output associated with education may arise from other omitted variables (such as inherited ability), which may be correlated with but not causally related to the number of years spent in school.

These results are consistent with T.W.Schulz`s (1975) hypothesis that the value of education is likely to be greater in a modern environment. In traditional environments, technology and markets change very slowly. Here, discovery of optimal economic behavior in the use of technology and the allocation of resources has occurred by a long process of trial and error and the results of this process can be replicated over the years and even from generation to generation. By contrast, a modern environment is characterized by continuous changes in technology and market situations. Facing a dynamic environment of this sort, farmers constantly need to adjust to new opportunities by taking decisions concerning new options, which did not exist before. Thus, changes in the technological environment increase the value of a farmer's "ability to deal with disequilibrium", and it is here that education may play a major role.[4]

Evidence generally consistent with this hypothesis has been found in previous studies. When the results summarized by Lockheen, Jamison and Lau were classified according to whether the regions are modern or traditional, they found that the effects of education are much more likely to be positive in modernizing agricultural environments than in traditional ones. However, as the authors indicated, the classification used in this survey utilized *ad hoc* variables to define modernizing agriculture, and it was not possible to examine whether the regions vary in other ways, which may mediate the relationship between education and productivity.

A paper by Figueroa (1986) compares the results from four Latin American country studies and concludes that education's contribution to productivity is greatest in modernizing region under examination before presenting the econometric results. The review of the Brazil and Mexico studies shows the problem of comparisons that include modern and traditional regions that also differ in ecological and economic characteristics.

In Mexico, the study included two traditional regions that were suffering from drought, together with two modern regions that had a good agricultural year. This introduces a problem

4 the original argument was presented in Schultz (1964); it has been further refined and developed in Schultz (1975). The quotation is from latter article.

given that the impact of education is being measured by gaps in the productivity obtained by farmers with high and lower educational levels. These gaps are reduced in a drought year when the regional variance of yields tends to fall. Figueroa recognizes that there are also difficulties in the comparison arising from differences in cropping patterns: education has an effect on the production of maize in regions where this is the most important crop, but has no distinguishable effect on maize where it is a secondary crop. The Brazil study suffers from a similar problem: its authors conclude that education has its greatest effect in modernizing regions, but arrive at this conclusion by comparing a modern region that has a widespread irrigation system with a rain - fed traditional region suffering from intense drought. An important methodological lesson arising from Figueroa's review is that, to be valid, the comparison of traditional and modern regions must ensure that other features that distinguish the regions do not mediate the observed differences in the contribution of education to productivity.

Benhabib and spiegel (1994) found that education level was an important determinant of differences in agricultural productivities among countries. They hypothesized and confirmed that education had a positive effect on farmers' productivity in all 38 countries data set. Their argument was that schooling helps farmers to use production information efficiently, as a more educated person acquires more production action and so it is a better producer.

Phillips (1994) reviewed an additional 12 studies using 22 data sets 9 with more recent data and greater representation of Latin America), and was able to confirm the general trends noted above. The average increase in output owing to an additional four years of schooling in the studies he considers is 10.5 percent, with the relevant figures for traditional versus modern farming systems at 7.6 and 11.4 percent, respectively. However, his survey was sufficiently geographically diverse to show that (under certain conditions) the effects of schooling are stronger in Asia than in Latin America, irrespective of the degree of modernization. This may have implications for the assumed applicability of Asian findings to Africa, though too few studies using African data were included to draw strong conclusions.

Appleton and Balihuta (1996) point out that these surveys included only two African studies (both on Kenya) and that education was not found to be significant in either. They review several additional African studies and find that the effect of schooling on agricultural output is usually not significant, thought in some cases it can be large, indicating that there is substantial variation in returns to schooling both within and between the areas surveyed. The authors suggest several possible reasons for the lack of significance of education in the African studies, including small sample sizes (for a few of the studies), errors in measurement of farm production, and wide variation in the actual effects of education on agricultural output in different areas and under different farming systems. These reviews illustrate the need for further investigation of the effects of education on farm productivity in Africa.

Studies Specific to Ethiopia

Until recently, very little empirical evidence was available to illuminate the effects of education in Ethiopian agriculture. Much of the recent research may be criticized on the grounds of poor measurement of education variables and small sample size. However, a variety of data sets and methods have been used in this context, providing some insight in to the effects of education on productivity and efficiency in Ethiopia.

Mesfin (1994) investigates technical efficiency in cereal crop production in Ethiopia using aggregate data for the period 1980-86. The data on education are weak. Although conclusions must be drawn with caution, he reports that primary schooling tends to increase productivity, while secondary schooling has no effect.

Assefa (1995) followed the three-stage procedure to test the impact of education on technical efficiency of small holders in Ada and Baso woredas. First he formulated a stochastic frontier production function with composed errors and then he estimated the coefficients using the maximum likelihood technique. Then he concluded "secondary school education, oxen, time of fertilizer delivery, and extension contact are the most important factors influencing technical efficiency in Ada sub district"(Assefa, 1995).

Abrar (1996) also used the same procedure to identified differences in technical efficiency among his sampled farmers and he attributed these variations to differences in farmers' socio-economic factors such as farm and household size, age, and the level of off-farm activities (Abrar, 1996).

Abay (1997) tested the hypothesis of equal allocation and technical efficiency of educated and illiterate farmers by using the modified Y-L profit function model under various linear restrictions. The results showed that educated farmers are relatively and absolutely more efficient than illiterate farmers. This implied that at the existing level of factor endowments and technology there is a potential to increase agricultural output by making illiterate farmers to operate closer to the efficient level achieved by their educated neighbors. It is also showed that expansion of schools and increasing enrollment rates in rural area have higher payoff than in modern areas at least in increasing the probability of farmers to adopt fertilizer input. Moreover, he also indicated that education increases not only the efficiency of farmers but also the probability of farmers to adopt improved inputs such as fertilizers.

Assefa and Abay (1997) estimate a stochastic frontier profit function to investigate technical and elective efficiency of farmers. Their data are also drawn from the ERHS. However, only four of the 15 sites were considered, and with in those four sites, only those households who used fertilizer and hired labor were included (120 households in total). Education in measured in two ways: (1) a dummy variable equal to one if at least one household member reports being able to read and write or has the ALP certificate; and (2) a dummy variable set equal to one if at least one household member has completed primary school. They estimate average inefficiency over their sample of 46 percent. Educated farmers were found to be relatively and absolutely more efficient than those without education.

Croppenstedt and Mulat (1997) use data from the ERHS, selecting eight sites dominated by oxen-plough cultivation, to estimate efficiency using a mixed fixed-random coefficient regression model. They include four alternative education variables: a dummy indicating that another household member can read and write a letter (self-report); a dummy indicating that the household head has completed primary school; and an estimator of the number of years of schooling attained by the household head, calculated based on the highest education level attained. They find that literacy has a positive effect upon productivity, and that education is weakly correlated with farm efficiency.

Croppenstedt and Muller (1998) examine the effects of various forms of human capital upon capital upon agricultural productivity using data from the first round of the Ethiopian Rural Household Survey (ERHS), but do not find a relationship between their measure of education and agricultural output.

Croppenstedt, Mulat and Meschi (1998), using data from a 1994 USAID (United States Agency for International Development) fertilizer marketing survey, find that literate farmers and more likely to adopt use of fertilizer than those who are illiterate, though the quantity of fertilizer demanded does not demand upon literacy.

Dercon and Krishnan (1998), using panel data on six sites covered by ERHS survey and found that the decline in poverty between 1989 and 1994 was greater for household heads who had completed primary schooling than for those who had less (or no) education. Poverty reduction is defined by a headcount measure in terms of greater consumption per adult equivalent across the two periods. The decomposition results suggest that the educated were able to take better advantage of opportunities to increase consumption over this period.

Finally, Lelissa Chalchissa (1998) employed Probit and Tobit models to examine and quantify the determinants of fertilizer adoption and the intensity of its use in Ejere district.

The results showed that agro-climatic, land tenure condition, credit, extension contact, oxen, ownership, age of farmer, family size, farmers' level of education, manure, ratio of price of crops to fertilizer cost, distance to fertilizer distribution center and cropping pattern are the most important determinants of fertilizer adoption and intensity of its use.

In sum, this body of research is suggestive of the possible benefits of schooling in agricultural areas in terms of increasing efficiency and the adoption of innovations as well as in reducing poverty. However, there is at present no convincing direct evidence to quantify the magnitude of the effect of education upon cereals output (especially on teff production) in rural Ethiopia. That is the aim of this paper.

Economics using well designed and presented questionnaires, collected the data. However, some minor errors in recording interview results and/or in data entry were identified. For instance, two HHs used 1.33 kg of fertilizer for one hectare of land .The main reason for such figures is suspected to be the coding system. Therefore by critically examining such errors an attempt has been made to correct them. Some other minor adjustments have also been done in other variables.

4.1.2 Study Areas

(i). Sirba -Godiet (Debreziet)

The village *Sirba- Godeit* is located in Ada woreda in East Showa province. The village is connected to the main road that connects Addis Ababa and Nazriet. It is located about half way between *Debreziet and Mojo*. According to the census in 1994, the total population of the village was noted 1,900, with 180 households. Of these, 176 households are male headed and the rest, 25% are female headed. The sample size from this village covers 95 households.

***(ii).* Yetmen**

Yetmen PA and *Yetmen* kebele (a small town on the territory of the larger *Yetmen* PA) are situated at southern end of Enemay Woreda in East Gojjam zone. *Yetmen* is located about 248kms north west of A.A between the towns of Dejen and Bichena. Motta borders it in the north, in the east and southeast by Wollo and North Shewa administrative regions and in the west by Colla Dega Damot (see picture in the Annex). *Yetmen* is an area suitable for agriculture. There are two rivers surrounding the PA: *Muga* is perennial while *Yegdifin* existS only in the wet season. The total area of *Yetmen* is estimated to be 9,300,000 sq meters of which about 87% is under cultivation and about 9.2% is communal grazing land. An official, but probably accurate, estimate gives the total population of *Yetmen* PA in 1996 was 2,491, over52% of whom are women. The sample size from this village covers 61 households.

Yetmen PA is located on an all weather- road to major towns of region 3. Hence, it is not cut off from any major towns during the rainy season. In *Yetmen* PA, a common form of plough cultivation is practiced in the production of all staples. The principal subsistence crops grown in this area include maize, several varieties of wheat, teff and numerous varieties of barely, broad beans, lentils, onions, garlic, red peppers, potatoes and cabbage. In addition to these crops a number of pulses, oilseeds, vegetables and spices are grown. Most of the crops are grown in the Meher season. For the major season the time of planting varies from the beginning of June to the end of September depending on altitude, drainage, the crop, and yearly variations in the beginning of the rains. Harvesting begins in the mid- September and continues until after Christmas. In *Yetmen* people grow teff and wheat, much of which is transported to markets in Addis Ababa.

The principal livestock raised in this PA include cattle, mules. Donkeys, horses, sheep, goat, and bees. Though crop cultivation is the pivotal activity of *Yetmen's* economy, livestock are closely linked with agriculture and play an important part. The importance of raising livestock lies in is use as a source of oxen (for ploughing), pack animals (for transportation), dung (the major source of fuel), dairy products, meat and hides and skins.

(iii). korodegaga

In National Political terms *Korrodagaga* is part of Dodota Woreda of Arssi zone of region 4 or Oromia. The boundary between *Korrodagaga* and the neighboring peasant association in Shewa is Awash River, which people cross on a raft manually hauled across the river on a steel cable. *Korrodagaga* also shares a boundary with some peasant association in Sire woreda of Arssi zone from it is separated by the *Qalata River* (which prevents travel across the river during rainy month). But travel to Dera town (the capital of Dodota woreda) is possible: the walking distance is 3 – 3 and half-hours. *Korodegaga* is remote. It is located at the Northeast edge of Arssi administration zone, bordering on Eastern Shewa and is the farthest PA from the capital city of the region – Asela.

There were 304 households at the site and population was 1,400 according to PA sources in 1997. Though the population was larger compared to surrounding villages Korodegaga is large in area but it is poor. The rainy months are June and August. Except during the rainy months the area is very hot. The population gets their water either from the Awash River or the Keleta River. The Awash River is a steady water supply the people use all the year. There is no 'Belg' cropping season in the area, due to the absence of rain. Farmers can only produce during the Meher season. Maize, teff, and sorghum are principal crops.

The economy of the population is based on subsistence farming, characterized by small farm size and limited fertilizer use. The area is prone to climate related production fluctuation. Cropping is the primary source of income, but sales of animal products (dung cakes and milk) and firewood constitutes important income source. The common livestock are cattle, goat, sheep and donkey. The cattle are kept for milk, meat, ploughing, manure, and cash. Goats and sheep are kept for cash and meat, while donkeys are kept for transportation and cash. Traditional and low input substance agriculture remains by far the most important means of livelihood for the population (the technology of the community is based on the Ox Plough.

The nearest towns are Dera (25km south), Bofa (10km north) and Awash Melkawasa (8kmwest). There is a dirt road from the PA that runs 18km from the local town of Dera and manually from the raft (steel cable) to cross the Awash (see picture in the Annex). Until 1998, there was no market in the village. The nearest weekly market (Monday) is in Dera. There are grain and livestock marketing problems related to transport, since the PA is surrounded by the Awash and Keleta rivers.

(iv). Shumsheha

Shumsheha is one of the peasant associations located in Bugna woreda, North Wello administration zone. It is about 630kms north of Addis Ababa, about 110kms from the zonal town, 335kms from Bahirdar the regional town and 12kms south of the woreda town Legible. The population of Shumsheha was about 6,000 in 1994. About 40% of total area of the woreda is not arable and only 10% of the land area is cultivated.

The 80km-dry-weather-road locking Lalibela with the Woldia- Woreta all –weather road. A dry-weather road connects Shumsheha to Ayna, the former capital. The road to Sekota on the same line is constructed. Lack of well-constructed bridges and muddy roads make road transportation during the rainy season impossible. The only largest market at site is in Lalibela town, 12km from Shumsheha.Saturday is a big market day in Bugna as a whole and thousands of people meet every week in Lalibela for transaction. Lalibela is the nearest retail and wholesale (grain and livestock) market and is held on Saturday. Some farmers go as far as 30 to 40km to larger markets.

In Shumsheha, ox-drawn plough is the most usual implement of cultivation. The traditional way of production has persisted on the area. The crops grown are teff, sorghum, barely, peas, linseed, and lentils. The main livestock reared in this PA include cattle, goats, sheep and donkeys.

The agro-ecological characteristics of study areas including alttitude, rainfall, temperature, soil, and dominant crop are presented in the following table.

Table 4.1: Characteristics of Agro-ecological Characteristics of the study villages.

Characteristics	Debreziet (Sirba Godeti)	Yetmen	Korodegaga	Shumsheha
Altitude	1800-1900meter	1800-3500meter	1300-1500meter	1500-2000meter
Ava. Rainfall	860mm	750-850meter	600-700mm	650-750mm
Av.temprature	14°c-17°c	15°c-18°c	17 °c-19 °c	16 °c -18 °c
Soil	Sandy, black and red soil	Sandy, black and red soil	Sandy	Sandy
Major crops	Teff,wheat, beans,chickpeas,barely, maize and sorghum	Teff,wheat, beans,chickpeas,barely,maize and vetch (guaya)	Teff,wheat, beans, and peas	Teff,beans,chickpeas,barely,and peas

Source: Ethiopian Village Studies, 1996/97.

4.1.3 Categorization of Selected Woredas according to their access to technology and infrastructure

Based on the information about socio-economic Characteristics of the study areas above, four peasant associations (villages) were selected for this particular study. The sample includes woredas, which have relatively high access to road and market facilities such as Sirba Godeti and Yetmen, and woredas with poor access to road and market facilities such as Korodegaga and Shumshea.

The degrees of access to road and market are approximately measured by: distance from town, utilization of fertilizer, access to road (or road link of PA to the nearest town), number of markets and market days. For detail characteristic of the areas see table 4.2.

Table 4.2:Techniological and market characteristic of the study areas.

Villages	Modern Environment		Traditional Environment	
	Debreziet (Sirba and Godeti)	Yetmen	Korodegaga	Shumsheha
istance from town	Those villages are near to Debreziet town. It is about 15-20km far from Debriet).	7km far from ***Dejjen town*** and 15km from ***Bechena town.***	It is remote area and the farthest PA from the capital town of the zone. And it is far, 18km,from town *Dheera*, 12km from Awash *Malkassa,* and 25km from *Nazareth.*	. It is about 630kms from Addis Ababa, 335kms from *Bahirdar* and 12kms from Lalibela town.
Access to the main all weather road	Connected to the main road A.A to Nazareth.	Connected to the main road A.A to Bahirdar.	The PA is linked with the nearest town *Dheera* and *Awash Malkassa* by direct road 18 & 12kms far respectively. But it is not all weather roads and hence farmers should cross *Awash* by raft to reach *sodere* and then *Nazareth.*	Until 1996, there were not roads connecting the community with other big towns. Even there was no means of transport: the people have to walk about 120kms (a day and a half) to go to the next bigger town (after Lalibela), which is *Woldia.* Therefore, road access is very poor in this woreda.
Access to market	Much of the production is transported to Debreziet, Mojo and A.A. There is no cut-off from any major towns during the rainy seasons. The nearest town markets are Mojo and Debreziet far by 15 and 20 km respectively. There is no specific day of market.	Much of the production is transported to Bechena, Dejjen and A.A. There is no cut-off from any major towns during the rainy seasons. The nearest town market is Yetmen kebele far by 2km. There is no specific day of market.	In the PA there is no place or day reserved for the market. The nearest market places are *Dheera; Awash Malkassa* and *Nazriet.*The nearest town market is *Awash Malkassa* far by 12km. There is marketing problems in rainy season since the PA is surrounding by the Awash and Keleta rivers.	The only and largest Market at the site is *Lalibela* town, 12 km from *Shumsha.* And at the same time *Lalibela* is the nearest retail and wholesale (grain and livestock) market and is held only on Saturday.
% Of HH who use fertilizer	82.5%	75.5%	51.8%	9.2%

Source: - The 1999 Ethiopia Rural HH surveys.

4.2 Methodology

The literature on the effects of education on agricultural productivity is divided into two major camps: frontier versus non-frontier (direct) methods for estimating the production function. Choice of frontier or non-frontier techniques depends in part on the research question. It's the interest of this researcher in the estimated coefficient on schooling in the production function, non-frontier techniques will suffice. For those researchers who wish to investigate the magnitude and causes of inefficiency, consideration of the production frontier (and deviations from that frontier) would be more appropriate.

Estimation of the average (non-frontier) function permits efficiency ranking of firms, but gives no indication of the magnitude of inefficiency. If the frontier is a neutrally selected transformation of the average function, estimation of the average function provides information on the shape of the frontier, but not its placement. If not, estimation of the average function provides no information about the frontier (Schmidt and Lovell 1979).

4.2.1 Model specification

Differences in productivity among farms imply that different outputs are obtained from a given bundle of physical inputs. If we are interested in examining whether certain characteristics of the households, such as its level of education, have an effect on productivity we can do this by means of production function. Thus, it reads

$$\mathbf{Q = f(X, E)} \qquad (1)$$

Where Q is the quantity of output, that is the (maximum possible) level of output.

X is a vector of physical inputs (which include area cultivated, animal input, labor input chemical input, land quality, and rainfall).

E is a vector of variables that characterizes a particular farm (which include schooling, contact with extension agent, age, and received formal credit).

There are different types of production functions. The most common one is the Cobb-Douglas production function. A Cobb-Douglas (C-D) production has a number of linear in the logarithmic of convenient properties.

- It is easy to estimate.
- The parameters, measures the elasticities (assumed constant and between zero and unity) of output with respect to inputs.
- The parameter may be regarded as efficiency parameter, since for fixed inputs, the larger the parameter, the greater is the maximum output obtained from such inputs.
- It may show diminishing marginal returns and estimate returns to scale.

But the possible disadvantage of C-D production function is that it can not show both increasing and diminishing marginal returns in a single response curve (i.e. it assumes constant elasticity of returns).

An alternative function form widely favoured for production function analysis is the translog function. It is described as a "flexible function form" since the scale coefficient can vary for different levels of production and different factor properties. Furthermore, the curvature of the isoquants, measured by the "elasticity of substitution" can also vary at different points on the production surface, whereas it is fixed at unity for C-D function. But translog production function is widely used in non-agricultural contexts.

The choice of function involves a certain amount of subjective judgment, as does the choice of inputs to include the function. It is possible to compare the value of R^2 obtained or use statistical tests of whether one model is an improvement on another, but since there is always some residual variation in output we cannot prove conclusively that one particular function is the correct one. Economic data do not obey exact laws; hence it is impossible to predict output exactly for a given combination of inputs. However, as we have seen above, Cobb-Douglas function has certain desirable characteristics from a theoretical point of view. Therefore, C-D Production function is used in this particular study in the analysis of both modern and traditional production functions.

If we begin with the C-D model in its simplest form, education excluded, we have

$$Q_i = \Pi (X_{ij}^{\beta j})\, e^{\alpha + ui} \quad \textbf{(2a)}$$

Where Q_i is the output of the i^{th} household, X_{ij} is the use by the i^{th} household of the j^{th} physical input, β_j is the elasticity of Y with respect to X_j and α and u_i are the constant and random error terms, respectively. The linear form of the model can be written as,

$$\text{Ln } Q_i = \sum \beta_j \ln X_{ij} + \alpha + ui \quad \textbf{(2b)}$$

If E_i is a measure of education in the i^{th} household, how should this variable be included in equation 2a? One way that education might be considered in the production function is in neutral fashion, that is, without altering the elasticity (β_j) of any of the X_j. In this formulation, E appears as an additional multiplicative input (Mook, 1981).

$$Q_i = \Pi (X_{ij}^{\beta j})\, E_i^{\gamma}\, e^{\alpha + ui} \quad \textbf{(3a)}$$

function is widely used in non-agricultural contexts.

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$$Q_i = \Pi (X_{ij}^{\beta j})\, E_i^{\gamma}\, e^{\alpha + ui} \qquad (3a)$$

Where γ is the elasticity of output with respect to E, education.

Since C-D production function assumes constant elasticity of substitution, it is possible to standardize output and physical input by hectare (i.e. land becomes an indicator of scale in the C-D production function). Therefore, Yield can be obtained from equation (3a) dividing it through out by land. That is,

$$\mathbf{Y_i = \Pi\ (x_{ij}^{\beta j})\ E_i^{\gamma}\ e^{\alpha + ui}} \quad \mathbf{(3b)}$$

Where Y_i is output per hectare (which is yield) and x_{ij} is non- land input.

To measure the effect of schooling, Cobb- Douglas (C-D) production functions may be specified in semi- log linear form as follows:

$$\mathbf{LnY_i = \alpha + \beta_1 LnL_i + \beta_2 LnN_i + \beta_3 LnOX_i + \beta_4 LnF_i + \beta_5 Lq_i}$$
$$\mathbf{+\gamma_1 S_i + \gamma_2 EX_i + \gamma_3 Cr_i + \gamma_4 Ag_i + \gamma_5 Ag_i^2 + D_I} \quad (4)$$

Where;

LnYi is the natural logarithm of farm output per hectare for household i;

LnN_i is the natural logarithm of total adult man-days of household i;

LnL_i is the natural logarithm of number of hectares under teff cultivation during the year by household i;

$LnOX_i$ is the natural logarithm of oxen owned by households i;

LnF_i is the natural logarithm of the quantity of fertilizer used by household i;

Lq_i is land quality of household i;

S_i is the formal education status of household i;

Ex_i is the extension contact of the household i;

Ag_i is the age of the household head i;

Ag_i^2 is the age square of the household i;

Cr_i is the received credit of the household i; and

D_i is the dummy variable for area difference within i's environment (i.e. within high and poor access to road and market access).

By using the above C-D production function, the following working hypotheses concerning the effect of education on productivity will be tested.

(i) Formal, non-formal and informal education have a positive effect on productivity.

(ii) The role of education is likely to be stronger in areas where access to road and market facilities are relatively high, utilization of fertilizer is more and distance from town is near than areas where access to road and market facilities are relatively low, utilization of fertilizer is less and distance from town is far.

4.2.2 Definitions and concepts

Formal education: - is defined as learning that takes place in schools.

Non-formal education: -is any organized or deliberate set of education activities carried outside the normal school curriculum. This category includes agricultural training program (or extension practice) and adult literacy classes.

Modern environment: - is an area where access of infrastructure and market facilities is relatively high, Utilization of fertilizer is more and distance from town is near.

Traditional environment: - is an area where access of infrastructure and market facilities is relatively low, Utilization of fertilizer is less and distance from town is far.

Lem soil: -is the most fertile type of soil.

Tef soil: -is the least fertile type of soil.

Lem/tef soil: -a type of soil in which its fertility is between tef and lem soil.

4.2.3. Measurement of variables

The dependent and independent variables employed in the analysis are defined as follows.

Dependent variable

1.**Yield (Y):** It is measured by teff output in kg per hectare.

Explanatory variable

2.**Land (L):** Area of land cultivated with teff in hectare.

3.**Labour (N):** Total adult equivalent man-days (family and non-family) per household for teff production

4.**Oxen (OX):** The number of oxen owned by household

5.**Fertilizer (F):** chemical fertilizers in terms of kilograms per hectare for teff production.

6.**Education variables:** Two different types of education are distngushinged in this study: "Formal education" is defined as learning that takes place in schools; "Non-formal education " learning outside the normal school curriculum. This category includes agricultural training program and adult literacy classes.

(i). Formal Education

Several different measures of education may be used, and different members of the household may be considered (e.g., households' head versus all non-head adults in the household). If education is measured as the number of years of schooling attained, the estimated coefficient represents the percentage increase in outputs for one extra year in school. Here, several possibilities exist, including: years of schooling of household head alone, average years of schooling of all household members or the total years of schooling of educated adult household member. Interpretation of the education coefficient depends upon the specification chosen. Fore example, the coefficient on average years of schooling of household member (not transformd) in a C-D specification represent the percentage increase in farm output for an additional year in the average education of all household members.

Therefore, for this particular study formal education is measured by an *average year of schooling* of all household members in order to capture the educational status of all adult and non- adult household members. To account for the possibility that different level of schooling have different effects upon output, a set of dummy variables to representing different level of schooling may be used. That is, for illiterate household members we use a dummy 1, for read and write or adult literacy program we use dummy 2, for a range of 1-6 years of schooling we give a dummy 3, and finally for a range of 7and above years of schooling we give a dummy 4. Then we multiply these weights with a number of members of households in each range and hence we can calculate average schooling of the household, (i.e.; by dividing the total weight by the total number of membersd of the household).

(ii). Non- formal education: In the case of non- formal education, we concentrated on *extension contact* of the head of the household before the survey was considered. The variable takes 1 if there was any extension contact one year before the survey, 0 otherwise.

7.Age (Ag): The age of the farm household head. Age is a proxy for experience in farming, it affects productivity of farmers, but the direction is not clear.

8. Received formal credit in cash or/and in kind (Cr): The variable indicated whether the household received credit from a formal institution for agricultural activity previous to the survey. Therefore, those farmers who obtained credit before the survey for agricultural activities are given the value of 1 and 0 otherwise. It is expected that the variable would have a positive impact on productivity.

9.Woreda difference one (D_1): 1 if farmer is operating in Sirba Godeti woreda, 0 if farmer is operating in Yetmen woreda.

10.Woreda difference two (D_2): 1 if farmer is operating in Korodegaga woreda, 0 if farmer is operating in shumsheha woreda.

The dummy variables (D_1 and D_2) used in the production function of the two environments may capture the effect of area difference within modern and traditional environments (e.g. agroecological difference, distance from town and access to road and market facilities).

11. Land quality (Lq): 1 if the soil is lem and/or lem- tef soil, 0 if the soil is Tef.

4.2.4 Estimation technique

The estimation techniques employed in this study is OLS (Ordinary Least Square). The Least-Square estimator has very attractive statistical properties that have made it one of the most powerful and popular method of regression analysis, including linearity, unbiased ness, and minimum variance. But before running a regression using OLS method different tests have to be conducted to check for any violation of the OLS assumptions. To this end the outliers in the data were cleared out so as to avoid the violation of the assumption of normality. The computer packages that are used to enter and estimate the data are the Statistical Package for Social Sciences (SPSS) and STATA.

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CHAPTER FIVE

RESULTS AND DISCUSION

5.1. Descriptive Statistical Analysis

The variables hypothesized to affect farmers' productivity were selected to fit the Cobb – Douglas model. Table 5.1 shows the means and standard deviation of the variables under both modern and traditional environment for the sampled households used in this study. The table illustrates that households with high and poor access to road and market facilities have different types of production function.

Some of the farm variables are presented in logarithmic form. Input values of zero were transformed by adding the constant one to facilitate taking logs, as is common practice (see for example; Jacoby, 1992). Jacoby notes that the choice of constant is arbitrary, but should be small relative to the average value of the input for the whole sample. Therefore, for this particular study, man-days and oxen values of zero were transformed by adding a constant one.

The mean values of most variables are greater in woredas where access to road and market facilities (modern environment) is high. As depicted in the table 5.1; the average productivity of land and labor are highest in Sirba Godeti and Yetmen where access to road and market facilities are higher than Korodegaga and Schumesheha where access and facilities are poor. Similarly, ownership of oxen is higher in Sirba Godeti and Yetmen (2.7) than in Korodegaga and Schumesheha (2.5).

The mean values of both formal and informal education are more in areas where access to road and market facilities is relatively high than where the accesses are low. In addition to that, consumption of fertilizer per hectare by households in modern environment is two and half times more than of households in traditional environment.

Table 5.1: Mean and standard deviation of the variables used in the production function by farmers.

Variables	Modern Environment		Traditional Environment	
	Mean	S.D	Mean	S.D
Output in kg/hectare	1214	1.31	987	1.48
Land (in hectare)	0.81	4.33	0.79	3.45
Labor in man-days/ hectare	144	156.4	84	52.4
Oxen in number	2.7	2.4	2.5	2.2
Average Formal education in index	0.66	0.4	0.41	0.49
Extension contact	0.24	0.2	0.14	0.04
Fertilizer Per hectare In kg	06.6	4121	12.7	527
Land Quality	0.19	0.3	0.15	0.08
Age-HHH	45.4	14	44.6	13.5
Age Sq-HHH	2270	1123	2243	121 2
Credit	0.24	0.43	0.22	0.12
Woreda Dummy	0.10	0.12	0.06	0.04

Source: own survey data.

5.2. Regression Analysis

The Ordinary Least Square (OLS) estimates of the production function for both modern (M) and traditional environment (T) are presented in table 5.2. But before running a regression using OLS method different tests have been conducted to check for any violation of the OLS assumptions. To this end the outliers in the data were cleared out so as to avoid the violation of the assumption of normality. All variables hypothesized to influence farmers' productivity were checked for both multicollinearity and hetroscedasticity. Whether problem of multicollinearity exist or not was checked against a bivariate correlation matrix of the SPSS econometric package. And variables that showed highly significant co-linearity were systematically excluded from the model (fore example rainfall). On the other hand in the OLS estimation method the disturbance term, which accounts errors in the measurement and omitted variables, need to have constant variance. Therefore whether problems of hetroscedasticity that violate this assumption exist or not was checked. The graph of standardized residual against frequency of their occurrences showed the normal distribution of the residuals, which indicate the absence of the problem of hetroscedasticity.

Major input variable (such as land, labor, oxen, fertilizer and land quality) and characteristics of the HHs (like education, extension, age and credit) were included in the Cobb-Douglas production function. The result of the production function shows that there are significant differences in the contribution of those variables to teff productivity under modern and traditional environment.

Table 5.2: OLS estimation of a Cobb- Douglas production Function

Dependent variable: Natural Log of teff produced per hectare (LN-Yield).

Variables	Coefficients	
	Sirba Guditi and Yetmen (M)	**Korodegaga and Schumeshha (T)**
Constant	3.11 (1.66)*	4.38 (1.69)*
LN-LAB	0.304 (3.08)***	0.445 (3.07)***
LN-OX	0.405 (2.88)***	0.231 (3.42)***
LN-LAN	0.304 (2.99)***	0.323 (3.74)***
LN-FER	0.16 (3.72)***	0.13 (1.77)*
AVEDU	0.0024 (2.56)**	0.0006 (1.89)*
EXT	0.0021 (1.78)*	0.0031 (0.74)
CRE	0.0013 (0.46)	0.0022 (0.39)
AGE	-0.241 (0.71)	-3041 (0.46)
AG^2	0.036 (1.07)	0.027 (1.24)
LQ	0.0095 (1.01)	0.0055 (1.01)
WD	0.0061 (3.09)***	0.018 (2.86)***
R^2	0.398	0.352
F-values	1.12**	1.31**
No.Obser.	153	256

Source: Survey data

Note: - *, **, and *** indicate significant level at 1%, 5% and 10%, respectively.

(i). Physical Inputs

Before analyzing the effect of education on farm productivity, a brief discussion of the results with respect to other variables is in order. The coefficient of labor, land and oxen are positive, highly significant in the production function of both environments. It can be seen that the output elasticity of the farm yields with respect to labor and oxen are larger in environments compared to other household characteristic variables (like education, extension, credit and age).

Land, labor and oxen are positive and significant at 10 percent probability. For example, assuming all other factors held constant, a one percent change in the size of land will bring about more than 0.30 and 0.32 percent change in the level of productivity in areas with high and poor access to road and market facilities, respectively. The possible explanation is that if farmers have more access to land, they are encouraged to use improved farming techniques through extension participation (i.e. irrigation, consumption of chemical fertilizer, pesticides and improved seeds) and hence output per hectare will increase. The result on land goes in line with finding of Croppenstedt and Mulat (1997) and Wendwoson (1998). Assuming other inputs remaining constant, more of the variation in productivity would come from change in the size of cultivated land.

On the other hand, other inputs remaining constant, the respective percentage output variation attributed from a one-percentage change in the number of oxen and man-days of the household are around 0.40 and 0.31 in modern environment, and 0.23 and0.44 in traditional environment respectively.

This supports the notion that oxen and labor are among the most important and basic farm inputs (assets. The positive and significant coefficient of labor suggests that labor availability-possibly at peak times of weeding is a production constraint for some households. The variable oxen may also proxy the wealth status of a household. They are a source of cash and security against risks of crop failure. This result is consistent with the results of Donel. etal (1997) and indicate that wealthy farmers are relatively less risk averse and hence are faster to use new technologies. The elasticity for the physical inputs adds up to 1.009 in n modern environment production function, 0.99 in traditional environment implying that essentially constant return to scale exist in the production of teff in the two areas.

(ii) Formal Education

The relationship between formal education and agricultural productivity is positive, and statistically significant in both environments. That is, keeping other inputs constant, the higher the level of education of members of the HH, the more likely a household is productive (i.e. additional year of schooling has positive effect on teff productivity). However, the estimated effect of schooling is seen to be strong in modern environment compared to that of traditional environment. The coefficient of education in Sirba Godeti and Yetmen is significantly different from zero at 0.01 levels. For example, other inputs remaining constant, additional year of schooling is expected to bring about more than 0.2 and 0.06 percent change in the level of productivity in Sirba Godeti and Yetmen (in modern environment), and Korodegaga, and Schumesheha (in traditional environment), respectively.

The result indicated that additional years of schooling were associated with an increase in teff productivity in areas where access to road and market facilities is higher. In contrast, in areas where access to road and market facilities is lower, the average increases in teff productivity attributable to additional years of schooling is relatively small and only with 10% level of significance.

This finding is fully consistent with T.W. Schultz's (1975) hypothesis that the positive effect of education upon output is dependent whether or not the farmer is living in a "modernizing" environment. Specifically, the effect of education appears to be stronger and positive in areas with provision of roads or of access to marketing facilities, fertilizer, and better crop varieties. In traditional areas, where marketing facilities and access to road are constrained, there are fewer tasks for education to fulfill, and schooling has weaker effect on productivity.

In summary, the analysis suggests that there seems to be a positive effect of formal education on the production of teff in both areas, but a stronger effect occurring in woredas where access to road and market facilities are high. This supports the working hypotheses of this study that formal education has positive effect on productivity and the role of education is likely to be stronger in areas where those access and facilities are relatively high.

Finally, sets of threshold dummy variables were created in order to have better understanding about the relative importance of different level of schooling. Each indicating that the household head attained a specified category of schooling. That is, schooling variables are measured in the following form in order to capture the threshold effect of formal education.

Head of household: Dummy 1 if head is of grade 1 to 3, otherwise 0

: Dummy 2 if head is of grade 4 to 6, otherwise 0

: Dummy 3 if head is of grade 7 and above,

Otherwise 0

The choice of 3 years as a breaking point is based on the generalized assumption that a minimum of 3 years of schooling is necessary for an individual to achieve and train functional literacy.

Table 5.3: OLS Production function, the threshold of impacting schooling on productivity.
Dep. Variable: Natural log of teff yield (LN-yield)

Variables	Coefficients	
	Sirba Gudeti and Yetmen	Korodega.& Schume.
1-3 years of schooling	0.05	0.29**
4-6 years of schooling	0.25**	0.10
7 and above years school	-0.14	-0.12
R^2	0.35	0.39
F-values	1.13**	1.24**
Number of observation	156	253

Stars indicate significant using two-tailed t- test as follows: **=0.05

Table 5.3 provides strong evidence of a threshold effect for schooling. The effect of education for HH head is significant at 5% level for those with between 4 and 6 years of schooling complete in Sirba Godeti and Yetmen and between 1 and 3 years of schooling complete in Korodegaga and Schumesheha. However, secondary schooling adds nothing to the productivity. Indeed, the negative (though insignificant) coefficients on the dummy for having grade seven or complete are not unexpected, since those who spend more years in school will have spent less time in the fields as most may have developed negative attitudes towards farm labor.

Generally, the level of threshold dummy variable differs across areas, increasing with the complexity of the technology found in each area. It is lowest in areas with poor access to road and market facilities, where only "some'' schooling has effect, and is largest in areas where access to road and market facilities are relatively high, complete primary education show positive effect. There is good reason to expect the educational threshold to be different where the tasks imposed upon education are different.

This result is supported by Cotlear (1990). In his study of education effect on farm productivity in Peru, he found that there is a threshold regarding the amount of schooling needed to have an impact on productivity and that the level of this threshold depends on the degree of modernity, that is, the complexity of the technological and market problem that need to be solved. The greater their complexity, the larger the minimum level of education required to obtain an impact on productivity. This suggests that, while the generalization of literacy in traditional environment (or areas with poor access to road and market facilities) may act as a catalyst speeding traditional environment in to the first stages of technical change, further technological development will require higher level of formal education.

(iii). Non-Formal Education

We argued that if extension transmits specific information about technologies or market structures, the impact of extension participation is measured by a productivity differential. In both areas coefficients for the effect of extension are positive; however, it is significantly different from zero at 10 percent significant level in Sirba Godeti and Yetmen .The explanation is that since the effect of extension on productivity should occur through a wider use of extension packages (like chemical fertilizer) and this did not occur in Korodegaga and Schumesha. That is, the response to extension in area with poor access to road and market facilities is low, as this agriculture has no or poor access to more productive technology.

Experiences show that in traditional environment like Korodegaga and Schumesha adoption of new input occur in a sequence. Peasants reach the use of the frontier package of technology after proceeding through a succession of slow stages (piece meal adoption). Hence, the package promoted by the extension services would be too complex to be appropriate for the needs of farmers in traditional environment or areas, where farmers were only starting to get acquainted with the use of low doses of chemical fertilizers. On the other hand, in Sirba Godeti and Yetmen most farmers are already using the modern package and the extensionists had in their message few elements that could improve the use of this technology under local condition.

Thus, sometimes, in the absence of formal education, non-formal education has a lot of contribution to increase agricultural production. Using fertilizers and high yield varieties may increase output greatly in agricultural areas with low literacy rates. The speed of these adoptions can due in part to the relative simplicity of the innovations. Often requiring only the replacement of one seed by another and the addition of chemical fertilizer, where chemical fertilizer had already been introduced little change in farming practices is required. Hence, if more productive technologies can be produced in forms that farmer can substitute easily for current practices, and therefore the demand for formal education to obtain and calculating ability may be less.

(iv). Technology and Credit

In this study, only fertilizer is taken as a technology variable because other technological variable like improved seed and small number of farmers in the two environments utilized herbicide (or pesticides).

The use of fertilizer is positively related to the farmers' productivity and is highly significant at 1-% level in Sirba Godeti and Yetmen. Other things remaining constant the respective percentage productivity variations attributed from change in the consumption of fertilizer are around 0.18 and 0.02 in Sirba Godeti and Yetmen, and Korodegaga and Schumesha, respectively. Thus in areas where access to road and market facilities is high utilization of fertilizer can have substantial effects on yields. The few households that are already using fertilizer in Korodegaga and Schumesha seem to be still in the phase of learning the use of this technology since in this area the variable is positive but it is significant at 10%.

However, Use of formal credit does not have a coefficient different from zero in any of the areas. Possible explanations are: (i) farmers may use the credit for other purpose than agricultural activities; (ii) lack of effective application of inputs; (iii) the amount of credit may be small; and (iv) managerial skills of farmers could be poor.

(v) Other Variables

Age, being a proxy for experience as well as attitudes towards modernization and risk-taking in agriculture, is expected to have a positive impact on output. In table 5.2, however, the coefficient of age for the two areas (although not statistically significant) shows a negative sign. That is, productivity declines, as the head of the household gets older. In other words, older farmers are not physically able to produce as much as younger households because farm experiences are countered by declined physical strength and perhaps by negative attitude towards innovation.

The other variable, land quality, is not found significant to affect productivity in both traditional and modern areas. But the effect of land quality is stronger and of the expected sign when site (woreda) difference dummies are omitted. This indicates that land quality is highly linked with the Woreda.

Finally, the site dummy variables (D1 and D2) are found to have a positive and significant impact up on productivity in both Sirba Godeti and Yetmen, and Korodegaga and Schumesha. Agro-ecological difference (like altitude, availability of rainfall, average temperature during cropping season, slope of land and access to road) may explain for positive and significant impact of site dummy variable on productivity.

According to farmers, the unseasonable and heavy rains that delayed planting and other operations were the primary factors affecting yields. In addition to that, if seed and fertilizer arrive late, farmers are forced to plant later than they would have liked. Therefore, under the assumption of high transport cost, condition is relatively favorable for farmers in areas with better access to road and relatively nearer to towns like the study villages Yetmen and Sirba Godeti.

CHAPTER SIX

SUMMARY AND POLICY IMPLICATION

Agriculture is the mainstay of the Ethiopian economy. It provides livelihood for the majority of the population and constitutes a large share of the country's GDP. However, agricultural productivity has been low for decades and the food security problem is quite common to most regions of the country. Several reasons can be cited for the low productivity of agriculture among which low level of education in rural areas (the means of developing and conveying essential information required by farmers to increase their productivity and the productivity of land) is one.

Therefore, this study has tried to look into the role of education on teff productivity. Any form of education, which imparts knowledge about the production process directly; or which enhances the capacity to acquire knowledge about production process from other source, should raise the individual producer's surface of production possibilities. With any particular combination of inputs, the producer with more production relevant education can (and will) produce more output.

The data come from the Ethiopian Rural Household Survey conducted by Addis Ababa University, Department of Economics, covered 1681 households in 18-peasant association spanning 15 woredas in 4 regions for the agricultural year 1999. The output is teff, the principal food crop of the country. The study has applied the cross- sectional econometrics for estimating the contribution of education in teff production for selected villages.

The indicator of the farm household educational background include years of formal education (an index) and extension service contact. Formal education facilitates capacity the capacity to search for information and in order to systematize this information. Agricultural extension service also helps the farmer to take these types of information, explaining the technical details and the likely consequences of the use of new technology.

We have shown in this paper that education can be seen to be an important factor in raising productivity among small farmers. The effect of formal and non- formal education were explored and found that this type of education can increase the productivity of the farmer. However, the impact of schooling depends on other complementary attempts (like access to infrastructure and market facilities) that are made to change the farming environment.

This study found that the effect of schooling is stronger in modern environment where accesses to infrastructure and market facilities are relatively higher than in traditional environment where those access and facilities are poor.

Also, as to schooling, the result shows the existence of a threshold- effect, by which formal education begins to have an effect on productivity. In areas where access to infrastructure and market facilities is relatively poor it seems that a little schooling (1-3 years) results in a positive impact on productivity. In contrast, in modern environment where access to infrastructure and market facilities are better a farmer who completes primary education level can be expected to obtain a higher level of productivity. That is, the number of years necessary for an effect to appear seems to increase with the complexity of the technologies involved. This suggests that, while basic levels of education may be effective in speeding traditional environment into first stage of technological development and will require higher level of formal education. With respect to non- formal education, we examined the effect of extension on productivity. This study has examined that the effect of agricultural extension on teff productivity is positive in both areas. Productivity gain from agricultural extension is highest in Sirba Godeti and Yetmen since the effects of extension can occur through a wider use of inputs like fertilizer and improved seeds.

The finding presented here suggests that both formal and non- formal education have an important role to play an increasing agricultural production in rural Ethiopia. Productivity may be enhancing either through the adoption of more productive inputs and techniques or through improvements in productive efficiency for a given technology.

These findings have important policy implication. As briefly pointed out in chapter two, not enough is being done in the way of expanding both formal and non-formal education. In spite of all efforts to provide education for rural people, only a very fraction of school age students get schooling chance. The findings of this study indicates that education is likely to increase the productivity of farmers who are living in areas with poor access to road and market facilities if only other complementary attempts are made to change the farming environment through the provision of roads or access to making facilities, fertilizers, better crop varieties and other infrastructure and technological services. All said, concerted effects are needed from all concerned so that we will able to use education for economic growth in general and agricultural production in particular.

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DECLARATION

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

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This thesis has been submitted for examination with my approval as a thesis supervisor.

Name of supervisor: ______________________

Signature: ______________________