This is to certify that the

dissertation entitled

Lessons from Ethiopia's High-input Technology Promotion Program: How the Organization of the Fertilizer Subsector Affects Maize Productivity

presented by

Julia C. Stepanek

has been accepted towards fulfillment of the requirements for

Ph.D. degree in Agricultural Economics

Major professor

Date December 14, 1999

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LESSONS FROM ETHIOPIA'S HIGH-INPUT TECHNOLOGY PROMOTION PROGRAM: HOW THE ORGANIZATION OF THE FERTILIZER SUBSECTOR AFFECTS MAIZE PRODUCTIVITY

By

Julia Caley Stepanek

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1999

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ABSTRACT

LESSONS FROM ETHIOPIA'S HIGH-INPUT TECHNOLOGY PROMOTION PROGRAM: HOW THE ORGANIZATION OF THE FERTILIZER SUBSECTOR AFFECTS MAIZE PRODUCTIVITY

By

Julia Caley Stepanek

Given high population growth rates, subsistence, low-input agriculture, and consequent low and stagnant incomes, a challenge for economists and development practitioners in Sub-Saharan Africa is to identify sustainable models of input intensification to promote agricultural productivity. Ethiopia is used as a case study of how one county's experience with the challenge of introducing smallholders to high-input technologies and simultaneously making steps to liberalize the agricultural output and input markets.

Ethiopia is one country where fertilizer use has increased dramatically since the early 1990s. This success has been largely attributed to aggressive promotion of a high-input farm technology package first promoted through the Sasakawa/Global 2000 (SG) Program and later incorporated on a much larger scale into the government's New Extension Program (NEP) (accounting for roughly 76 percent of imports and 30 percent of rural households in 1998).

Qualitative and quantitative survey work in 1998 revealed that it is questionable whether extension, credit, and input markets were sufficiently developed to sustain long-term productivity gains in maize production. The NEP acts as a surrogate for the credit and input markets–often compromising the development of the improved seed and fertilizer open markets, and private initiatives to extend smallholder credit.

There were signs in 1998 that there was an unmet demand for credit and administrative delays in issuing credit led to delayed fertilizer deliveries. The quality of extension was also suspect. A household fixed effects yield model revealed that quality extension (timing and appropriate interaction between inputs) is an important component of using the high-input technology efficiently. However, in 1998 the number of farmers per extension agent in the NEP far exceeded the ratio under the SG program, thus likely hindering the quality of extension.

Another concern regarding long-term production of high-input technology is whether the input market in 1998 forced many farmers to pay artificially high prices for fertilizer. Institutional change by introducing more competition in the retail market is one avenue for developing a lower-cost fertilizer market. A hedonic fertilizer price determinates model revealed that fertilizer prices are significantly higher in areas of the country where governments appointed markets relative to regions where a fertilizer auction was implemented. It is also possible to reduce costs through changes in the organization of importing and wholesaling by taking advantage of the seasonal price trends for fertilizer on world markets, as well as in domestic transport rates. Simulated farm budgets revealed that the proposed cost-reducing changes can reduce the risk and improve the profitability of adopting the high-input technologies.

DEDICATION

Dedicated to Mommy, Daddy, Ahlia and Vanessa.

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ACKNOWLEDGMENTS

I am indebted to a great number of people for helping to develop this research. I'd like to begin by thanking my dissertation advisor, Dr. Thom Jayne, and my committee: Dr. Valerie Kelly, Dr. John Strauss, Dr. Eric Crawford, and Dr. Michael Weber, and a heartfelt thank you to Dr. Mulat Demeke of the Addis Ababa University in Ethiopia. I would also like extend a warm thank you to Dr. Julie Howard for her continued support and encouragement.

Thank you to Dr. Strauss--for his patience and keen insight into my econometric models. Dr. Weber, thank you and the US Agency for International Development/MSU Food Security II Cooperative Agreement for continued financial support for without which this research would not be possible. Val, I thoroughly enjoyed working with you, and appreciate your confidence in me. Most importantly, Thom, thanks for giving me this research opportunity, for your continued words of support: "don't lose faith", and for overall making my years at MSU an invaluable learning experience.

A particular warm thank you goes to my colleagues at the Grain Market Research Project--Asfaw Negessa, Daniel Molla, and Ali Said--for continued patience in fielding my questions about how things really work in Ethiopia. An appreciative thank you to the Ethiopian enuminators responsible for the Input Subsector Survey, the cornerstone of this research: Mesfin Tadesse, Shirega Minuye, Taye Yadefa, Demeke Abate, Lelissa

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Chalchissa, Techane Adugna, Arkiso Masebo, Belaineh Taye, Beyene Taddesse, and Belay Kebede. Thank you for your diligent work and infectious enthusiasm. Thank you also to Dr. Kassahun Aberu for his diligent work on helping us to understand the process of importing fertilizer. Dr. Mulat and Val, I am particularly grateful to your commitment and assistance in conducting the Input Subsector Survey. Thank you.

There are also a number of faculty and staff in the Department of Agricultural Economics at MSU that were valuable contributors to my research. Thank you to Dr. Frank Lupi, Dr. Roy Black, Dr. Kelly Raper, and Dr. Dan Clay for their time and invaluable advice. Dr. Mywish Maredia was also very helpful–in helping me to understand the SG farm surveys. I would also like to thank Josie Kelly for coordinating my travel, fielding editing questions, and always providing a smile on cloudy days.

I would like to extend a my deepest appreciation to Karin Steffens, Erin Boydston, and Anwar Naseem for their unwavering warmth, support, and for being my sounding board. Karin, I can't say enough how grateful I am for your invaluable guidance and continued support (and for always agreeing to get coffee with me). Erin, thanks for your immense friendship and generosity. Anwar, thanks for your unwavering encouragement and confidence in me. Thank you also to my officemates--Dr. Bocar Diagana, Dave Mather, and Bishwa Adhikari--for great patience and for always providing timely comic relief.

Lastly, a big hug for my family, my mom, dad, and sisters--Ahlia and Vanessa–who always believed I could do it!

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KEY TO SYMBOLS AND ABBREVIATIONS

ADD	Agricultural Development Department
AISCO	Agricultural Input Supply and Coordination Organization
AISE	Agricultural Input Supply Enterprise
CERES	Crop-Environment Resource Syntheses
CSA	Central Statistical Authority
DAP	Diammonium Phosphate
EAL	Ethiopia Amalgamated, Ltd.
EGTE	Ethiopia Grain Trade Enterprise
FA	Farmer Association
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
GMRP	Grain Market Research Project
ha	hectare
km	kilometer
kg	kilogram
MSU	Michigan State University
MT	metric ton
NEP	National Extension Program
NFIA	National Fertilizer Industry Agency
SC	Service Cooperative
SNNPR	Southern Nationalities and Nations Peoples' Republic
TGE	Transitional Government of Ethiopia
USAID	U.S. Agency for International Development

quintal = 100 kilogram

CHAPTER 1

INTRODUCTION

Approximately ninety percent of Sub-Saharan Africa's (SSA) rural population is currently considered poor (Pinstrup-Andersen and Delgado 1994). The sources of this poverty include low agricultural productivity due to declining soil fertility, rising population density, and low levels of commercial input use. Continued low agricultural productivity and rapid population growth together imply that food security in the region will remain threatened.[1] SSA food production per capita declined at a rate of more than 2 percent per year from the late 1970s to the early 1990s (Badiane and Delgado 1995). The projections of future productivity are equally as bleak. Africa's population is projected to almost double between 1995 and 2020. By 2010, 70 percent of the world's food-insecure people will be in SSA; every third person in the region is likely to be food-insecure, compared with every eighth person in South Asia and every twentieth person in East Asia (Pinstrup-Andersen et al. 1997).

Development theorists concur that agricultural intensification (the use of yield-enhancing technologies to increase production) can help increase rural incomes and in general, lead to an agricultural structural transformation--the transition from a low-

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[1]"Food security exists when all people at all times have physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life" (USDA 1996:2).

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income, low-productivity, subsistence-oriented economy to one characterized by specialized, high-input agriculture and a rise in rural incomes (Timmer 1990). An agricultural transformation is usually necessitated by increasing population density and increased land scarcity, which both put pressure on agricultural sectors to adopt intensive, high-input technologies (Boserup 1961, 1981). The rising incomes that generally accompany the use of high-input technologies, in turn, stimulate consumer demand for market goods and thus facilitate a structural transformation of the economy (Mellor 1990).

The development of the Asian economy provides evidence of the potential for technology to pave the way for economic development in SSA: The main lesson of the Green Revolution in Asia (and in Latin America) is that the "adoption of yield-increasing technologies is a 'plus-plus' solution, since it can increase food production and farmer incomes, while reducing the cost of food to consumers and improving diets, i.e., it can result in economic growth and poverty reduction simultaneously" (Borlaug and Dowswell 1995).

For over a decade, the Sasakawa-Global 2000 (SG) program, in partnership with African governments,[2] has promoted the Green Revolution approach to development by introducing African farmers to high-input technologies such as improved seed and fertilizer. Through a collaborative effort, the Sasakawa Foundation (recently renamed the Nippon Foundation), The Carter Foundation's Global 2000 program, and Norman

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[2]SG programs have operated in Ghana, Benin, Togo, Nigeria, Guinea, Mali, and Burkina Faso in West Africa, and Ethiopia, Eritrea, Tanzania, Mozambique, Sudan, Uganda, and Zambia in Central, East and Southern Africa.

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Borlaug, the Nobel Peace Prize laureate, have demonstrated the potential for high-input technology to raise foodcrop productivity across SSA. Pilot programs that introduce high-input technologies through half-hectare farm-managed demonstration plots have had significant success in raising yields, net incomes, and returns to labor for a variety of food crops.

Unfortunately, SSA has had limited success in achieving long-term adoption of improved agricultural technologies by farmers. SSA governments have a history of supporting agriculture through direct subsidies for fertilizer and input credit, and also sometimes through grain purchases at above-market prices. They also have a history of introducing farmers to new technologies through various pilot programs in which government agents or parastatals provided extension education and delivered inputs. However, the high costs of maintaining these programs and expanding them to the general population often resulted in severe budget deficits. In many cases, governments were forced to withdraw support; and "disadoption" of the new technologies frequently followed since input markets were not sufficiently developed to encourage sustained use (Jayne and Jones 1997; Eicher 1985; Howard and Mungoma 1997).

Agricultural productivity growth in SSA in the 21st century will come from a political commitment to creating open markets and strengthening the institutions[7] that reduce the cost of transactions (North 1989). Developing the necessary African political commitment to agriculture is a key challenge: "Africa has never been given a chance to

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[7]"Institutions are rules, enforcement characteristics of rules, and norms of behavior that structure repeated human interaction" (North 1989:1321).

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succeed. Colonial control protected special-interest agriculture, as have newly independent African governments. Only today is Africa opening to market-based national, regional, and global opportunities" (Stepanek 1999:108). African governments are challenged to enter a partnership with the private sector to encourage long-term productivity gains.

At the dawn of the 21st century, the challenge to SSA countries to improve agricultural productivity, increase food-security, and reduce rural poverty remains. The need for a solution is increasingly urgent. This research used Ethiopia as a case study to observe one country's experience with introducing high-input technologies to farmers while simultaneously trying to liberalize input and output markets in order to ensure long-term, sustainable productivity gains and an increase in rural incomes.

1.1 The Ethiopian Situation--Moving Toward a Solution?

Food security in Ethiopia over the last few decades has been threatened by two periods of famine[8] severe enough to warrant international attention. In the mid-1990s, an estimated 52 percent of Ethiopia's population was food insecure (i.e., below the poverty line) as defined by the Federal Democratic Republic of Ethiopia (FDRE)[9] (1996). There is some evidence in Ethiopia of a transition from an agricultural system based on traditional

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[8]Famines occurred in 1973 and 1984/85.

[9]The Transitional Government of Ethiopia (TGE) changed its name on August 23, 1995 to the FDRE.

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technologies to one based on improved technologies. This transition has been quite recent, however, and it is not yet clear that it will be complete.

The index of per capita food production in Ethiopia grew from 98 to 106 between 1993 and 1996, but then dipped to 103 in 1997 (FAO 1997).[10] The aggregate production of key food crops increased dramatically during the last decade: wheat increased by 111 percent, sorghum by 44 percent, barley by 35 percent, maize by 30 percent, and tef by 14 percent (CSA 1990/91-1997/98). Increases in cropped area contributed somewhat to this growth in production, but given the already high population density[11] and growth rate (3 percent per annum), future increases in production are unlikely to come from area expansion. Good climatic conditions in the mid-1990s may also have accounted for some of this improvement,[12] but there was also significant growth in fertilizer consumption (from 29,668 tons to 168,23 tons between 1981 and 1997 (NFIA 1998)). Much of Ethiopia's increase in fertilizer use and some of the growth in production has been attributed to the use of the Sasakawa Global 2000 (SG) model, first as a pilot program limited to fewer than 3,200 farmers and later as a major national extension program (NEP) that had a goal of 3.6 million participating farmers for the 1998 cropping season (out of a total of about 10 million rural households).

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[10]The decline in 1997 may be due to the fall in production by 26 percent from 1996 to 1997 (FAO/WFP 1997).

[11]5.5 persons per hectare of arable and permanent crop land per capita versus 3.6 persons per hectare on average in SSA in 1997 (FAO 1999).

[12]There were incidences of drought in 1988, 1991, 1992, and 1994, but 1996 and 1997 were relatively more favorable harvests (World Bank 1997).

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The FDRE has been thus far commended for its role in encouraging productivity gains in agriculture: The NEP in Ethiopia is considered one of SG's most successful national programs. On paper the FDRE has made a move toward agricultural sector decentralization by liberalizing input and output prices. However, by restricting private sector access to credit and retail markets, the input sector, in particular, remains heavily controlled by the national and regional governments. Despite the progress in introducing improved technologies to farmers, many preconditions for the sustainable use of these technologies are not yet fully in place.

1.2 The Challenge of Promoting Sustainable Agricultural Growth in SSA

Many SSA counties face the challenge of simultaneously introducing high-input technology to smallholders and reducing direct government support of agricultural input and output markets. Evidence from other countries can serve as a harbinger for Ethiopia. Government efforts across SSA to introduce improved technologies to farmers through explicit or implicit agricultural subsidies and/or extension programs often succeeded in raising the level of input use in the short-run. With their expansion, however, agricultural programs quickly ran into budgetary pressures and became unsustainable.

Experience from Tanzania and Ghana reveal the problems of moving from a pilot SG program to expanded and sustained increases in input use. The SG program provided credit, a high level of extension supervision, and facilitated input delivery--bypassing the cumbersome administrative channels of national extension programs. The challenge is to scale-up the SG pilot extension programs into national programs and to sustain the level of inputs once the SG draws to a close. Some countries (e.g., Ghana and Ethiopia) developed national extension programs based upon SG principles, but it has been difficult to duplicate the success because part of the SG success was contingent upon the program being small-scale (it thus provided close supervision and partially subsidized inputs and credit). Although the SG program has demonstrated that the technology exists on the "shelf" to significantly increase yields in some areas of SSA, the difficulties in maintaining the increased yields once the pilot extension programs withdraw highlights the challenge of forging sustainable national systems of research, extension, input supply, and credit. Addressing the potential adoption of high-input technologies, Farrington states:

> What is less clear is whether 'parallel' systems set up to test, advise on and provide inputs for these technologies completely independently of existing research and extension services can achieve anything more than a very temporary alleviation of chronic, deep-rooted problems" (Farrington 1995:131).

Sasakawa-Global 2000 began operating in Tanzania in 1989. In 1991/92, program participants in the Arusha Region of Northern Tanzania averaged maize yields of 4.9 tons per hectare, up from the national average of 1.4 tons per hectare (Putterman 1995). However, this success was ephemeral--the SG program bypassed the dysfunctional input and credit markets by delivering the recommended package and credit to program participants on its own accord. It is unlikely that program participants would have seen such yields without SG's delivery of inputs and credit. Institutional credit and input delivery systems had collapsed under earlier "reform" measures--functions previously handled by regional c

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When the SG withdrew from Arusha's Arumeru district in Tanzania, SG feared "disadoption" from the high-input technology. The SG therefore arranged for TechnoServe (a US-based NGO) to organize farmers' associations, enabling the SG to continue to guarantee loans to these farmers' associations and even deliver inputs on occasion (Putterman 1995). The SG program neglected to address the necessary and critical issues of developing private sector input and credit delivery mechanisms, without which adoption of high-input technology is not sustainable. Putterman states, "Rather than being the spearhead of a Tanzanian Green Revolution, SG 2000 seemed all too likely to become yet another dimly remembered foreign-funded project" (Putterman 1995:320).

Similar to the case in Tanzania, there is evidence that the SG pilot extension program in Ghana may have compromised its objective of promoting long-run increased food productivity (Yudelman et al. 1991). At the program's inception in 1986 it was expected that the delivery of extension services would work in harmony with public and private credit and input supply institutions. However, it was quickly realized that if farmers were to adopt the technology package, SG would have to extend credit (from its own resources and national banks) and arrange for input delivery. Instead of strengthening existing institutions, the program thus created its own delivery channels, thereby avoiding the problem of input market development.

Farmer participation in the SG program in Ghana escalated in five years from 40 farmers in 1986 to an estimated 17,000 in 1990 (Yudelman et al. 1991). As the program expanded, the SG nc

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expanded, the SG no longer had the resources to sustain the level of input delivery it provided at the program's inception. Its ability to maintain it effectiveness thus became severely strained. Not only was the provision of inputs problematic, but loan recovery was inadequately managed and the quality of extension services declined (Yudelman et al. 1991). Over the course of the program, the number of farmers per extension agent rose ten-fold from an average of 15 farmers per extension officer at the start of the program (Yudelman et al. 1991). In an evaluation of the SG program in Ghana, it was belatedly recognized that scaling up the program would require simultaneous institutional changes (Yudelman et al. 1991).

Ghana's experience warns Ethiopia of the danger of scaling-up pilot extension programs such as the SG without also upgrading supporting institutions. However, Ethiopia struggles with not only scaling-up the successful technological transfer seen in the SG program, but also with the simultaneously withdraw of government support to agriculture. The experience of Zimbabwe and Zambia offer insights into this process.

Zimbabwe is an example of a country in which dismantling government-supported agriculture raised unforseen challenges and triggered a regression from the maize production gains achieved in the 1980s. The Government of Zimbabwe is now challenged to accelerate agricultural productivity growth through a government/private sector partnership.

Zimbabwe achieved unparalleled success in diffusing hybrid maize seed both before and after independence. However, as Eicher stated, "Zimbabwe's smallholder-led Green Revolution represented a 'qualified' success story because of its lack of fiscal sustainability" (199

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sustainability" (1995:831). Part of the success was attributed to an increase in smallholder credit in the early 1980s. Credit was often perceived as an entitlement, supervision was inadequate and delinquency rates were high.

In 1991 Zimbabwe launched economic reforms to reduce maize subsidies. However, liberalization met with the "disadoption" of fertilizer. For the period 1985-89, fertilizer use by the smallholder sector averaged 119,000 tons, but fell to 98,000 tons in 1990-92, and fell again to 86,600 tons in 1993-94 (Jayne and Jones 1997).

Neighboring Zambia faced similar difficulties in maintaining the level of fertilizer use after decontrol of the input and output markets and credit delivery. Fertilizer use quadrupled between the 1960s and late 1980s due in part to a subsidy of 30 to 60 percent of the landed cost of fertilizer in the 1970s and 1980s (Jansen 1988 in Howard and Mungoma 1997), and also due to the extensive smallholder credit program in place during that time. Until the early 1990s, roughly one-quarter of rural households received loans each year (GRZ 1991 in Howard and Mungoma 1997). Subsidized credit was available to smallholders through a system of cooperative depots. Input subsidies, coupled with a controlled output market that guaranteed producer prices, resulted in a favorable incentive structure for agricultural intensification. However, budgetary pressures in the mid-1980s threatened the sustainability of institutional support.

By 1992 President Chiluba in Zambia began to dismantle the parastatal system. Large-scale farmers benefitted from the resulting increased trade (due to the liberalization of the foreign exchange market), but Zambian smallholders suffered (Howard and Mungoma 1997). Fertilizer use fell by 25 percent between its peak in 1986-87 and 1994-

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95 (CSO/MAFF 1995 in Howard and Mungoma 1997). This "disadoption" can be partially explained by the increase in the nitrogen-maize price ratio from 3.3 in 1971-1989 to 5.4 in 1990-94 (Heisey and Mwangi 1997).

The experiences of Tanzania, Ghana, Zimbabwe, and Zambia reveal the difficulties of sustaining high-input use after the government withdraws its agriculture programs. In each country, governments tried to subsidize their way to higher input use rather than developing sustainable private sector systems. Private markets were thus insufficiently developed to promote the sustained use of the new technologies when governments withdrew support. The experience of these countries highlights the need to develop a role for government in agriculture that complements, rather than supersedes, the private sector. These lessons are timely, as Ethiopia is currently in the position to scale up its own SG program and simultaneously liberalize input and output markets.

1.3 Research Objective

The objective of this research is to determine the degree to which Ethiopia is on the path to sustaining agricultural productivity gains by examining government extension services to introduce farmers to high-input technologies, and the extent to which private input markets are developing that will ensure long-term adoption of the new technologies. The research will seek to determine whether there is an important causal relationship between input market development, quality extension services, access to credit, and productivity growth of maize. The thesis of this research is that productivity gains for maize can be achieved through organizational changes in the structure of the import and distribution stages c

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distribution stages of the fertilizer subsector. The underlying assumption of the research is that raising rural incomes and improving food security in Ethiopia can be achieved by increasing agricultural productivity.

Historically, most fertilizer in Ethiopia has been applied to tef; however, recently, the relative share to maize has increased–due in part to the relative profitability. Across East and Southern Africa maize is the most important food staple due in part to the success of new maize seed and associated technologies in raising smallholder production (Byerlee and Eicher 1997). In Ethiopia, tef has historically been the dominant foodcrop, but maize is gaining an increasing share of daily diets (up from 21 percent of the daily calories per capita in 1993 to 30 percent in 1998 (FAO 1998)) and is generally the most productive food grain relative to tef, wheat, barley and sorghum.

The specific research questions and sub-questions asked in this dissertation are as follows:

(1) How is the expected return to fertilizer use on maize influenced by the organization of the inputs markets?

- In the 1990s did the expected return to fertilizer use encourage its adoption?
- For whom does the expected return to fertilizer encourage use?
- What are the determinants of fertilizer adoption and intensity of use?

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(2) To what extent is the system of extension and inputs (i.e., credit, fertilizer, and seed) sustainable in the long-run?

- What were the returns to fertilizer use by participants, graduates, and traditional farmers in the SG survey areas in 1997?
- What factors contributed to high maize yields in the SG program?
- Relative to the SG farmers, are farmers in the broader population that are not as well endowed with land, labor, livestock, and education, and farmers in less favorable agro-ecological areas able to use the program's recommendations of high-input technologies when the program withdraws?
  - What was the performance of the fertilizer subsector in 1998?
  - How can costs be reduced in the fertilizer subsector?
  - How can net income and returns to labor for the broader population be expected to change with cost-reducing changes in the structure and conduct of fertilizer import and distribution?

(3) What is the potential to develop a lower-cost fertilizer subsector? What policy changes would be required?

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Answering these questions will allow policy makers to make more informed decisions about how to create an environment that enables Ethiopian farmers to boost agricultural productivity.

1.4 Methods

This research employed various qualitative and quantitative methods to answer the research questions outlined above. The research coupled the Structure, Conduct, Performance (SCP) paradigm with a subsector analysis and two econometric models (a hedonic fertilizer price determinants model and a SG fixed effects yield model). These methods determined both the factors that are statistically significant in influencing agricultural productivity as well as how the structure and conduct of the inputs subsector (particularly fertilizer) influenced performance in 1998. The research also developed a simulation exercise involving a fertilizer financial import parity price and farm budgets. This method was used to evaluate the robustness of the profitability of the SG technology, and thus its potential to promote long-term productivity growth.

A subsector is a vertical slice of an economy--an "independent array of organizations, resources, laws, and institutions involved in producing, processing, and distributing an agricultural commodity" (Marion 1986). The subsector approach used in this research examined the transformation and transactions that occur as the commodity (fertilizer) moved through the stages of the vertical system from import to farmgate. What happens at one stage of the subsector may affect what is happening at another stage. Within each stage of the subsector, the SCP paradigm can be used to examine the horizontal interactions between the structure, conduct, and performance of each stage. In combination, the subsector analysis and SCP paradigm provided guidelines for examining the overall performance of the fertilizer subsector.

The SCP paradigm is used to evaluate the long-term sustainability of technology introduced by the SG and ultimately, to identify areas of policy intervention that could improve the performance of the import and distribution stages of the fertilizer subsector. The theory of industrial organization posits that the structure (S) of a market strongly influences the competitive conduct (C) of firms within a market, which in turn strongly influences market performance (P) (Marion and Mueller 1983, Scherer 1980). Market structure refers to the sources of discretionary economic power that firms in the industry can exercise (Staatz 1996), and market conduct refers to how firms behave in response to market structure. Evaluating performance is sometimes less straight-forward: 'Good' market performance is subjective and characterized by numerous ill-defined, often unquantifiable measures. In general, market performance is how well the market performs the tasks that society reasonably expects it to perform.

The SCP analysis is based upon a survey of the Ethiopian input subsector conducted in July and August 1998 by the Grain Market Research Project (GMRP).[13] The structured surveys targeted the three primary fertilizer consuming regions--Amhara, Oromiya, and Southern[14] Regions (Figure 1.1) (see Appendix1 for survey coverage and

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[13]A joint collaboration between the Ministry of Economic Development and Cooperation and the Department of Agricultural Economics at Michigan State University.

[14]Formerly called the Southern Nation, Nationalities and Peoples' Region (SNNPR).

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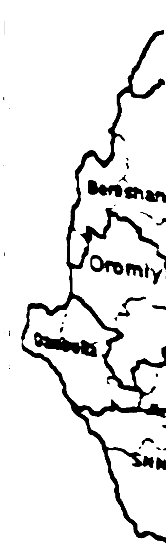

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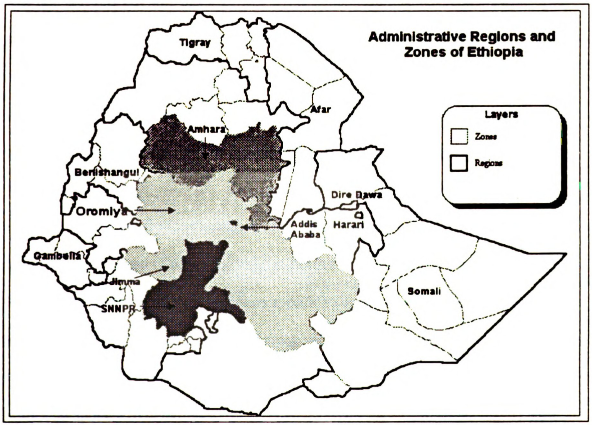
survey instruments). Importers and government officials in the Ministry of Agriculture and the National Fertilizer Industry Agency (NFIA) were surveyed in Addis Ababa. Within each region, wholesalers, retailers, Ministry of Agriculture officials, members of farmer Service Cooperatives, and transporters in select weredas (districts)[15] along the main roads out of Addis Ababa were also surveyed.

Figure 1.1 Map of Ethiopian Survey Areas, 1998
Source: UNDP-CUC 1996



[15]A wereda (or district) is a geographic subset of a zone. There are 11 regions in Ethiopia, 21 domains, 55 zones, and 371 weredas.

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Qualitative responses from the survey regarding the performance of the market in 1998 were complemented by a hedonic fertilizer price econometric model. The hedonic technique was used to determine the marginal implicit prices of different market characteristics, specifically market institutions. The model used cross-sectional retail fertilizer price data in the Amhara, Oromiya, and Southern Regions collected during the 1998 GMRP Input Subsector Survey.

Questions regarding the sustainability of the gains achieved through the SG pilot program (adoption of high-input technology) are addressed through econometric modeling, descriptive statistics, and a subsector analysis. Descriptive statistics are used to determine whether the farmers chosen to participate in the SG program have more resources in terms of land, labor, livestock and are better educated than the broader population living in the same vicinity, thus rendering them better suited to adopt the new technologies.

A production function approach to an econometric yield equation using household fixed effects is utilized to determine the significance of soil characteristics, physical inputs, managerial practices, and omitted factors specific to one farmer (such as farmer's ability, soil, and weather characteristics) in explaining variation in yields on SG and non-SG maize plots in Jimma Zone, Oromiya Region (Figure 1.1). The level of yields achieved is a critical component to determining the profitability of the high-input technology (Figure 1.2).

Agricultural productivity gains from the improved technology are represented by estimates of increased net margin, returns to labor, and marginal rates of return (based upon a farm-level

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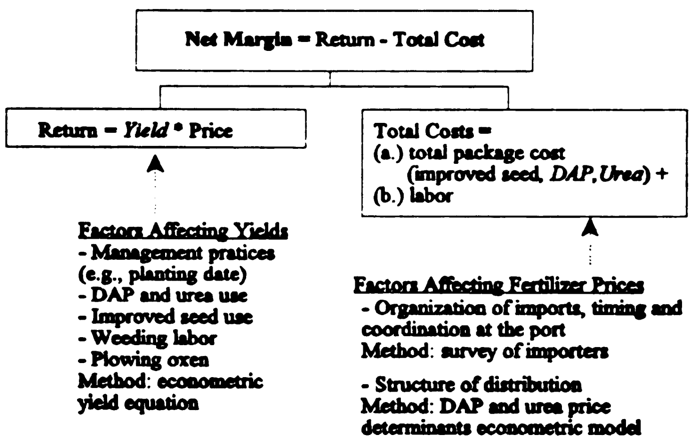
upon a farm-level financial analysis reported in Howard et al. 1999). The extent to which variations in yields and labor input affect profitability will determine whether expansion of the new technologies under stress conditions--to less favorable agro-ecological areas and to farmers that may not have sufficient resources to achieve optimum yields--is successful. Given the hypothesis that profitability of the high-input technology may decrease under conditions of stress, farm budget simulations are used to determine the extent to which the profitability of the improved technology can be improved through organizational changes in the fertilizer market that would reduce fertilizer prices (Figure 1.2).

Figure 1.2 Schematic Diagram for Simulated Maize Budgets



A financial import parity price will be calculated to show the cost build-up from import to retail. Simulations in the financial import parity price will help show the extent to which feasible reductions in the retail price of fertilizer affected the farmgate price of fertilizer. The estimated reduced fertilizer price will be entered into the SG crop budgets to determine the ex

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This research will thus use a variety of qualitative and empirical methods to examine fertilizer profitability for typical Ethiopian smallholders as the FDRE extends SG technologies beyond the better endowed farmers who participated in the SG 2000 program.

1.5 Outline

This research is organized in 8 additional chapters. Chapter 2 demonstrates the potential for high-input technology to raise the productivity of maize. Chapter 2 also outlines the profile of current fertilizer users and delineates the determinants of fertilizer use to understand whether fertilizer use will be profitable to a diverse population. Chapter 3 presents the structure of the fertilizer market, focusing on the effect of the regulatory environment established by the FDRE. Chapter 4 describes the conduct of the fertilizer subsector. Chapter 5 presents the cross-section hedonic fertilizer price determinants model that will be used to simulate changes in fertilizer profitability in chapter 8. Chapter 6 outlines farm-level determinants of maize productivity growth. Chapter 7 evaluates the performance of the fertilizer subsector. Chapter 8 demonstrates how fertilizer profitability can be improved through simulated cost reductions in the fertilizer subsector. Lastly, chapter 9 presents the conclusions and policy implications.

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CHAPTER 2

TRANSFORMING A LOW PRODUCTIVITY AGRICULTURAL SECTOR

The overall economic problem across SSA is that traditional agricultural practices do not produce the level of agricultural growth required to stimulate incomes and development in densely populated, land constrained economies. Intensified agricultural production is one avenue for increased rural incomes, stimulated demand, and economic development. In general, it is estimated that SSA needs to increase fertilizer use from 9 kg/ha to 30 kg/ha in the next decade if agricultural productivity is to meet food demand (Weight and Kelly 1998).

Ethiopia is no exception. Given the current low level of use of improved seed and fertilizer in Ethiopia there is great potential for agricultural intensification to raise crop productivity. In 1995/96 only a third of Ethiopian farmers used inorganic fertilizer, most at sub-optimal rates (CSA 1995/96). In addition, roughly less than 4 percent of farmers have used improved seed (CSA 1995/96).

Ethiopia has the technology to promote real productivity gains in agriculture. The joint effort of the National Field Trials Program (NFTP), Sasakawa-Global 2000 pilot extension program, and the expanded National Extension Program (NEP) have demonstrated that efficient use of high-input technologies can double and even triple yields.

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This chapter will examine the extent to which introducing high-input technologies is a viable option for Ethiopia to increase agricultural productivity, solve Ethiopia's food security problem, and promote an agricultural transformation. In Ethiopia, the magnitude of the productivity problem is illustrated by evidence that yield growth remains low (section 2.1) and the ability of farmers to practice traditional methods of restoring nutrients to the soil is mitigated by reduced farm size and competing usage of crop forage (section 2.2). Although the FDRE has a history of promoting policies and programs to promote agricultural development (section 2.3), the adoption of new technologies (section 2.4) and the intensity of use (kilograms/hectare) relative to recommended levels remains low (section 2.5). A review of the profitability of fertilizer use in Ethiopia sheds light on the feasibility and conditions of expanded fertilizer use (numbers of farmers and doses used) (section 2.6).

2.1 Cereal Yields

Agricultural productivity is not increasing at a rate to feed a population that is growing at 3 percent per annum. Demeke et al. (1998) provides a striking calculation to the severity of the problem. Given an average farm size of 1 ha for a family of 5, cereal yields (800-2000 kg/ha for maize) are barely adequate to feed household members (given a recommended 156 kg/person/year). Therefore, 60 percent of households that cultivate less than one hectare of land cannot be expected to generate sufficient cash income from farming after meeting their own consumption requirements (Demeke et al. 1998).

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From 1961-1998 maize yields grew at 1.6 percent/year, wheat by 2 percent, sorghum by 1.5 percent, and barley by 1 percent.[16] For maize, there is a significant structural change[17] between 1961-1977 and 1978-1998: from 1961-1977 there was positive significant growth of 2.4 percent/year, but from 1978-1998 there was neither a positive nor negative trend–yields remained constant. In the late 1980s fertilizer consumption began to increase steadily, however, maize yields remained constant, with no growth, from 1988-98. Part of the reason for lack of productivity growth in maize is that production has not outpaced area expansion over the last two decades: maize area increased 52 percent and maize production increased 42 percent from the 1980s to 1990-98 (calculated from FAO 1999).

Table 2.1 Grain Yields, 1980s-1998, MT/Hectare

Year	Maize	Tef	Wheat	Sorghum	Barley
1980s average	1.62	0.84	1.11	1.27	1.13
1990	1.61	1.42	1.32	1.32	1.16
1991	1.22	0.87	1.41	1.34	1.13
1992	1.52	1.04	1.34	1.22	1.06
1993	1.74	0.90	1.55	1.40	1.36
1994	1.23	0.70	1.07	0.93	0.94
1995	1.36	0.83	1.31	1.24	0.86
1996	1.68	0.93	1.21	1.35	1.06
1997	1.74	NA	1.29	1.42	1.06
1998	1.62	NA	1.37	1.10	1.09

Source: FAO 1999; tef data from Dejene, A. in Demeke 1995.

[16]Author's computation from FAO 1999 data. Demeke et al. (1998) also conducted a similar analysis with data from 1980 to 1995.

[17]Determined by the Chow test (1960) for structural change at 99.9 percent confidence.

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2.2 Status of Traditional Practice of Maintaining Soil Fertility

Agricultural productivity growth through use of commercial fertilizer is becoming more popular because traditional methods of maintaining soil fertility are no longer able to keep up with Ethiopia's mounting population pressure and arable land constraint. Since 1980 yields of maize, tef, sorghum, and wheat are not increasing at a sustained, positive rate, thus forcing farmers and policy makers to think of alternative means of increasing agricultural productivity. Declining soil productivity is an increasing farmer concern: among farmer households surveyed in 1995/96, 73 percent stated that they had seen their crop productivity decline between 1992 and 1995 (GMRP 1995/96). Similarly, among the reasons cited by farmers for increasing the amount of fertilizer used between 1992 and 1995/96, declining soil productivity was ranked number one followed by successful farmer experience with fertilizer (Demeke et al. 1998).

Increasing population pressure on the land translates into the demand for an agricultural intensive development strategy, one that is land-saving and labor-using. Ethiopian farms are small, reducing the option for fallow to restore nutrients to the soil. The mean size of cultivated household area in Amhara, Oromiya, and Southern Regions (82 percent of Ethiopia's population) in 1995/96 was 0.5 hectares in the Southern Region, followed by Oromiya and Amhara with an average of 1.3 hectares and 1.2 hectares, respectively (Table 2.2). In the Southern Region, the lower three quartiles of the population (75 percent of the population with the least hectares cultivated) had less than 0.52 hectares. In both Oromiya and Amhara, the lower three quartiles (75 percent of the households) had less than 1.24 hectares and 50 percent of the households had less than 0.7 hectares (Table 2.2).

Table 2.2 Mean Level and Distribution of Household Cultivated Hectares by Region, 1995/96

Region	Percent of Total Population	Mean Hectares Cultivated	1st Quartile[1] (mean hectare)	2nd Quartile (mean hectare)	3rd Quartile (mean hectare)	4th Quartile (mean hectare)
Tigray	5.4	0.89	0.21	0.49	0.84	1.97
Afar	1.8	1.03	0.27	0.76	1.10	1.91
Amhara	24.9	1.19	0.25	0.69	1.24	2.55
Oromiya	32.9	1.25	0.27	0.70	1.24	2.76
Somalie	2.4	0.70	0.12	0.37	0.72	1.59
Benishangul and Gumez	2.5	1.18	0.31	0.81	1.24	2.37
South	23.8	0.53	0.11	0.28	0.52	1.21
Gambela	2.3	0.58	0.06	0.26	0.57	1.38
Harar	1.3	0.58	0.22	0.41	0.64	1.03
Addis Ababa	1.5	2.32	0.61	1.49	2.65	4.56
Dire Dawa	1.2	0.70	0.15	0.41	0.63	1.63
National	100	1.02	0.19	0.52	0.99	2.34

Source: CSA 1995/96.
Note: [1]Quartiles are the division of households at the national level into 4 groups by hectares cultivated. The first quartile represents 25% of the national sampled survey that have the lowest level of cultivated hectares, the 4th quartile has the highest level of cultivated hectares.

Long fallows in SSA have been traditionally relied upon to recapitalize soils and restore yields; however, increasing population densities have thwarted this option-- cropped areas are not left to fallow for as long. The shorter fallow does little to restore soil organic matter. Fallows of 15 to 30 years are required to recapitalize soils (Weight and Kelly 1998). A soil's natural organic matter will decline over time without deliberate recapitalization. The little organic matter that is returned to the soil competes with other activities for use. Increasing deforestation forces farmers to use manure as fuel and organic matter is often fed to livestock. In addition, land scarcity requires households to supplement their l

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supplement their livestock's feed with crop forage. In the highlands, animals may only receive a maximum of 50 percent of their feed requirements through grazing (IFDC 1993).

There are concerns that rapid increases in use of commercial fertilizer will exacerbate environmental problems of increased soil acidification and water pollution. Although these are real concerns, the alternative is worse. In SSA "the potential for fertilizer to have positive impacts on the environment in general, and soil quality in particular, is much greater than the potential for it to cause environmental damage" (Weight and Kelly 1998:4). Agricultural intensification reduces extensive agricultural practices which can accelerate deforestation and soil erosion. An alternative to extensive agriculture is low-input sustainable technologies. However, the net benefit in terms of returns to labor and in sustaining soil fertility is less than the high-input technology alternative:

> However much they must respect traditional farming practices, agricultural scientists must resist the temptation to romanticize them. They must not succumb to the illusion that, confronted with explosive population growth, Africa's food needs can be met through the improved 'low-input sustainable' systems that are based largely on traditional practices but require much more from farmers in terms of labor, knowledge, and skill (Borlaug and Dowswell 1995:123).

In sum, Sub-Saharan Africa faces a food crises and organic matter does not provide sufficient nutrients to replenish those lost with crop production. Further, organic matter is increasingly scarce due to competing uses such as fuel and construction materials

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2.3 History of Agricultural Policy in Ethiopia

Ethiopia has a history of heavy direct government involvement in agricultural markets by state controlled firms purchasing grain, distributing agricultural inputs, and controlling trade and prices. During the 1990s the government liberalized output and input prices, but it remains to be seen whether the remaining government presence in the input market, in particular, will foster the development of a private sector input market that encourages sustainable use of high-input technologies.

The Imperial Government of Ethiopia developed four Five-Year Plans, but with little success in promoting agricultural growth (Molla et al. 1995). The First and Second Five-Year Development Plans (1957-1967) focused on developing large-scale commercial farms and export of coffee to the neglect of subsistence farming methods. The Third Five-Year Development Plan (1968-1973) was shaped by the surprising shift in the 1960s from national self-sufficiency in crop production to a net importer for the first time. The Plan was heavily influenced by the "Integrated Rural Development" programs fashionable among donors at the time. It emphasized building transport infrastructure, disseminating high-input technology, credit, and extension, and developing cooperative societies.

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Three comprehensive extension programs emerged;[18] however, they were costly and the benefits were heavily concentrated in select high-potential areas of the country. These factors prompted a geographic expansion of the program, but provision of fewer services: Minimum Package Program (MAPS) which provided fertilizer, credit, and extension. In effect, the MAPS were only located along major road ways and were poorly implemented (Workneh 1994 from Molla et al. 1995). During this time the Agricultural and Industrial Development Bank (AIDB) procured fertilizer and the Ministry of Agriculture distributed fertilizer to farmers.

The Fourth Five-Year Development Plan (1974-1978) identified cereals and pulses as the priority crops and was designed to continue with the package approach. However, the Plan was never implemented: the combination of the severe famine of 1973/74 and rising resentment of the Imperial Government's feudal land tenure system prompted the overthrow of the monarchy by the military in February 1974 (Molla et al. 1995). The Derg (military regime) instituted a radical land reform in 1975 titled Proclamation 31 whereby peasants were no longer indentured to landlords and land holdings in excess of 10 hectares were confiscated by the state and distributed to landless peasants or organized into state farms or cooperatives. However, although farmers continued to have usufruct rights over their holdings, the sale of land remained prohibited. When the reform measures were implemented, little land was actually redistributed and many landless farmers remained, making the new law prohibiting use of hired labor appear contradictory.

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During the first few years of the Derg, the volume of fertilizer distributed through the extension program continued to expand and the demands on transport and storage prompted the transfer of farm input marketing from the Ministry of Agriculture (MOA) to the Agricultural Marketing Corporation (AMC) in 1978. The AMC was established in 1976 with the mandate to control the marketing and distribution of grains, adding the responsibility for input markets "optimized use of storage and transport facilities" (Demeke 1995).

The AMC entered a partnership with the Ministry of Agriculture (MOA) whereby the AMC imported and distributed fertilizer to MOA marketing centers. The MOA was responsible for estimating farmer demand and distributing fertilizer to farmers on credit through roughly 18,000 peasant associations (NFIA/MOA 1987 from Demeke 1995).

Continuing with the monarchy's Minimum Package Program (MPP) under the MOA, the Derg implemented the MPP II from 1981-1987. MPP II expanded planned coverage three-fold, but the necessary financial support was lacking and therefore the actual coverage of the MPP II was limited in its ability to provide inputs and extension (Molla et al. 1995).

Both the MOA and AMC became increasingly inefficient: overstocking resulted from poor demand estimates and deliveries were delayed due to a lack of institutional coordination (Demeke 1995). In 1984 the AMC folded and the Agricultural Input Supply Corporation (AISCO) emerged under the Ministry of Agriculture. AISCO was responsible for importing, distribution to marketing centers, and retailing of agricultural inputs. In the same year, the MPP II was replaced by the Peasant Agricultural

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Development Program (PADEP) in which roughly 2,900 farmer service cooperates (SC) emerged as the institutional vehicle to extend inputs, credit, and extension to smallholders. Although input and output marketing responsibilities were now under one roof, AISCO also had is problems:

> ...lengthy bureaucratic process of securing foreign exchange, high import price, high freight costs, lack of proper port facilities at Assab, high cost of inland transport, problems of storage and transport, inaccurate demand estimates, and organizational inefficiency hampered the operation of AISCO (Demeke 1995).

A civil war in 1990/91 led to the overthrow of the military regime by the Transitional Government of Ethiopia (TGE). In 1996 the TGE announced its objective of doubling per capita incomes over 15 years and of narrowing the "food gap" (FDRE 1996). This daunting task presented the FDRE with the challenge of redefining its role in promoting agricultural intensification.

Grain markets were partially liberalized in the late 1980s and then completely liberalized in March 1990. The AMC was restructured into the Ethiopian Grain Trade Enterprise (EGTE) with the mandate to purchase grains for an emergency grain reserve. Since liberalization, the performance of the grain marketing system has largely improved. Econometric results revealed that *ceteris paribus* cereal price spreads significantly declined in most markets suggesting increased competition (Negessa and Jayne 1997). Wholesale prices in major surplus-producing areas increased while prices in consumer markets declined (Negessa and Jayne 1997). Overall, output market liberalization brought benefits to both pr

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FDRE efforts to liberalize the input market have lagged behind similar moves in the grain market. The Government of Ethiopia has a history of implicitly subsidizing fertilizer, but its currently stated policy (although not yet necessarily implemented) is to promote open, competitive input markets supported indirectly by government-funded extension services. In 1991 the TGE announced its plans to liberalize the agricultural input sector. However, during the mid-1990s fertilizer prices remained pan-territorial and subsidized.[19] In addition, although private importers entered the market, 3 out of 5 importers were actually companies owned by national or regional government interests. As with imports, wholesale and retail markets remained largely in the hands of government companies. It was not until February 1997 that fertilizer retail prices were liberalized and only in early 1998 that wholesale prices were liberalized. However, liberal prices does not necessarily result in a competitive market due to the government's continued control over marketing and farmer input credit. Overall, the research presented in this study is in the context of a dynamic, evolving market.

The Federal Republic of Ethiopia's (FDRE) agricultural policy has been two pronged: making steps toward liberalizing the output and input markets (more so for the output market), but also in promoting agricultural productivity growth thru improved extension services. In 1993 Sasakawa-Global 2000 (SG) began a pilot program in

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[19]Fertilizer subsidies ranged from 20 percent to 39 percent across the country until January 1997. The subsidy was a reaction to the fertilizer price rise that followed the devaluation of the Birr in the early 1990s.

partnership with the Ministry of Agriculture's (MOA) Department of Extension and Cooperatives. President Meles Zenawi commended the SG focus on improving agricultural productivity as the "best entry point for addressing the issue of food security in Ethiopia" (Zenawi 1998:25). The program objective was to introduce farmers to new technologies for a couple of years in hopes that after the program withdraws farmers would be convinced of the benefits of high-input technologies and would continue their use. The MOA/SG program was targeted to high-potential cereal growing areas and characterized by farmer-managed plots of 0.5 hectares, provision of fertilizer, seed, credit, and close supervision by the extension agent. The SG program was successful in raising net income and returns to labor for maize and tef (Howard et al. 1999). Based upon the same high-input technologies and practices, in 1995 the FDRE began to rapidly scale up the MOA/SG into a National Extension Program (NEP) with government-administered and guaranteed credit and government organized input distribution.

Overriding all agricultural programs is the importance of providing farmer access to credit. Input credit was historically channeled through service cooperatives in an arrangement between SCs and the banks. However, in the late 1980s and early to mid 1990s default rates began to rise and the government intervened in 1997 by guaranteeing input credit in order to encourage banks to continue lending to the agricultural sector (see chapter 3 for more details).

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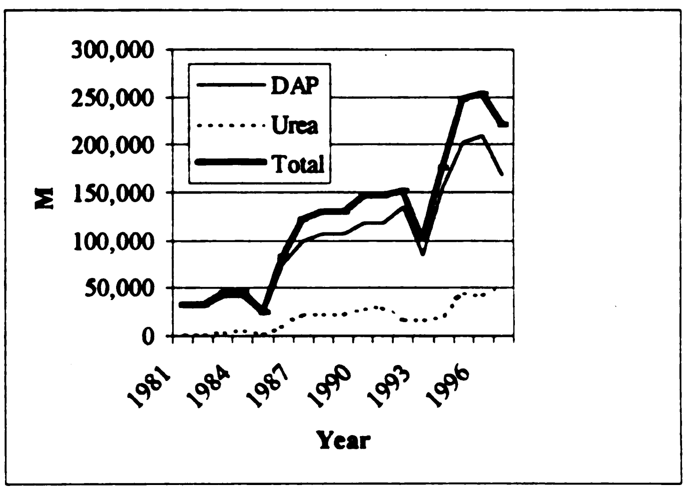
2.4 Level and Distribution of Fertilizer Use

In spite of efforts by the FDRE to develop the agricultural sector, agricultural productivity growth remains low and the majority of farmers practice low-input, even subsistence agriculture. Inorganic fertilizers in Ethiopia are used by approximately 30 percent of an estimated six million farm households and cover 37 percent of the cultivated area (CSA in Demeke et al. 1998). Fertilizer use in Ethiopia started from a very low base, and increased by 700 percent from 1981-1996 (Figure 2.1). By 1997, DAP consumption had reached 169,000 MT and urea use reached 52,000 MT.

Fertilizer use increased 41 percent annually between 1971 and 1979 (IFDC in Demeke 1995). This increase tapered off in the early 1980s as the price of fertilizer increased, but then rose again by the late 1980s (Figure 2.1). In the early 1990s fertilizer

Figure 2.1 Fertilizer Consumption in Ethiopia, 1981-1997



Source: FAO 1981-1997.

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use increased sharply primarily due to donor support, but declined in 1993 due to a 40 percent increase in the price of DAP (Demeke 1995). However, the market recovered and DAP consumption reached a peak in 1996 at 209,883 MT. The decline in 1997 may be attributed to the denial of additional credit to defaulting SCs and the fact that the NEP expansion had yet to reach a point of significant impact (as it did in 1998 with a planned 2.6 million demonstration plots). Urea consumption has historically been lower than the levels of DAP, urea consumption reached a peak in 1997 at 51,808 MT (Figure 2.1). Much of the recent increases in fertilizer use is attributed to the NEP. If in 1998 the NEP delivered 100 kg/ha of fertilizer for each of the 2.9 million planned farmers, then it consumed 290,000 MT of fertilizer, 76 percent of the total quantity imported in 1998.

Examination of the distribution of fertilizer users across regions revealed that fertilizer use is concentrated in regions of the country that are high-potential agro-ecological areas and that are close to Addis Ababa and therefore have relatively higher levels of infrastructure. Overall, in 1995/96 49 percent of the households the Oromiya Region used fertilizer; 39 percent in Amhara, and 36 percent in Southern Region (Table 2.3). The highest density of fertilizer users lay in the two regions of Addis Ababa, where 97 percent of households used fertilizer and Harar with 81 percent. However, these regions are largely peri-urban and do not reflect characteristics (i.e., underdeveloped markets) facing typical rural smallholders.

Table 2.3 Mean Percentage of Households Using Fertilizer by Region, 1995/96

Region	Percent of National Population	Percent of Households Using Fertilizer
Tigray	23	45
Afar	1	13
Amhara	22	39
Oromiya	38	49
Somalie	1	6
Benishangul and Gumez	12	23
South	26	36
Gambela	0	0
Harari	65	81
Addis Ababa	95	97
Dire Dawa	2	34

Source: CSA 1995/96.

Cereals receive the largest share of fertilizer in Ethiopia. In 1994/95, 99 percent of fertilizer used nationally went to cereals and 95 percent in 1996/97 (CSA 1995/96). Pulses and oilseeds received roughly 2 percent of total fertilizer applied. "Permanent"[20] crops such as chat, coffee, enset, tobacco, and cotton received roughly less than 3 percent of total fertilizer consumed in 1994/95 and 1996/97. However, the share of urea to "permanent" crops increased in 1996/97 to 6.6 percent of all urea used from 0.8 percent in 1995/96.

[20]The listed crops (expect coffee) are not necessarily permanent, but it is how they are classified by the Central Statistical Authority.

Table 2.4

Cereals
Pulses
Oilseeds
Others[2]
Permanent[3]
All Crops

Source: CSA 1

Notes: [1]There is

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Table 2.4 Proportion of Total Fertilizer Use By Crop, 1994/95 and 1996/97, '000 Quintals (QT)

	DAP				Urea			
	1994/95		1996/97		1994/95		1996/97	
	'000 QT[1]	Percent	'000 QT	Percent	'000 QT	Percent	'000 QT	Percent
Cereals	1,076.62	90.9	1,123.89	90.5	197.41	91.00	236.09	87.0
Pulses	53.14	4.48	42.66	3.4	6.52	3.00	9.74	3.6
Oilseeds	9.40	0.80	28.71	2.3	1.73	0.80	1.37	0.5
Others[2]	42.15	3.56	36.66	3.0	9.47	4.40	5.5	2.1
Permanent[3]	3.14	0.29	10.14	0.8	1.73	0.80	18.64	6.8
All Crops	1,184.72	100	1,242.06	100	216.86	100	271.34	100

Source: CSA 1994/95 and 1996/97.
Notes: [1]There is a discrepancy between these fertilizer use figures and the figures in Figure 2.1 due to different data collection methods of the sources.
[2]Fenugreek, spices, potatoes, other vegetables.
[3]Chat, coffee, enset, cotton, tobacco, fruits, other permanent. (Some of these crops are not necessarily "permanent" but it is how they are classified by the CSA.)

The shift in the share of fertilizer to individual cereals revealed changes in profitability. As government programs are designed to expand high-input use, it must be remembered that part of the equation for profitability, along with the input-output price ratio, is the net increase in yield achieved for a particular crop. From 1994/95-1996/97 the share of DAP to maize remained relatively constant, at 12 percent of total DAP allocated to all cereals (Table 2.5). However, an increasing share of urea to maize relative to tef during this period was observed, perhaps an indicator of the rising yield responsiveness of maize to urea (a top dressing–applied after planting, critical for cob nutrients), in combination with a favorable the input/output price ratio relative to tef (in part due to government input programs). From 1994/95 to 1996/97 the share of total ureato tef fell from 45 percent to 37 percent and the share to maize increased from 10 percent to 29 percent (Table 2.5).

Table 2.5

Tef
Barley
Wheat
Maize
Sorghum
Millet
Oats
Total

Source: CSA I

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Table 2.5 Quantity and Proportion of Total Fertilizer Use By Cereals, 1994/95 and 1996/97, '000 Quintals (QT)

	DAP				Urea			
	1994/95		1996/97		1994/95		1996/97	
	'000 QT	Percent	'000 QT	Percent	'000 QT	Percent	'000 QT	Percent
Tef	457.33	42.5	538.80	48.3	89.27	45.2	86.10	36.6
Barley	176.24	16.4	130.94	11.7	20.59	10.4	20.78	8.8
Wheat	250.71	23.3	238.80	21.4	55.40	28.1	35.18	14.9
Maize	137.23	12.8	135.76	12.1	190.71	9.9	68.99	29.3
Sorghum	6.88	0.6	14.59	1.3	6.78	3.4	17.51	7.4
Millet	43.36	4.0	56.52	5.1	4.09	2.1	6.47	2.7
Oats	4.87	0.5	**[2]	**	1.57	0.8	**	**
Total	1,076.62[1]	100	1,115.41	100	197.00	100	235.03	100

Source: CSA 1996/97 and 1994/95.
Note: [1]There is a discrepancy between these fertilizer use figures and the figures in Figure 2.1 due to different data collection methods of the sources.
[2]** denotes data not significant.

2.5 Intensity of Fertilizer Use

As with fertilizer adoption, the level (kg/ha) of fertilizer use in Ethiopia is low. Fertilizer was introduced to Ethiopia following demonstrations from 1967 to 1969. In the early 1970s, the Ministry of Agriculture (MOA) recommended 100 kg/ha DAP and 50 kg/ha of urea per hectare for all crops and all areas. Using the economic optimum rate[21] recommendations were revised after the Agricultural Development Department/National Fertilizer and Inputs Unit (ADD/NFIU[22]) conducted over 1,200 fertilizer trials from 1988 to 1991. The recommended rate of N-P_2O_5-K_20 (nitrogen-phosphate-potash) for maize on Nitosols (one of the most common soil types for maize production) is 75-80-0 kg/ha.

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[21]The economic optimum rate is the point on the yield response curve where the last Birr invested in an input will provide the farmer with a net return of one Birr (ADD/NFIU 1992).

[22]The NFIU was later renamed the National Fertilizer Industry Agency (NFIA).

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Table 2.6

Soil Type
Nitosols[1]
Cambisols
Andosols
Black soils
Grey Soils
Red Soils[2]
Brown Soil

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The recommended rate on Andosols, the other common soil type for maize, is 50-55-0 kg/ha (Table 2.6).[23]

Table 2.6 Fertilizer Recommendations for Maize, N-P_2O_5-K_2O, kg/ha

Soil Type	Shewa/Gojjam	Across the Country
Nitosols[1]	75-80-0	75-80-0
Cambisols	50-50-20	50-50-20
Andosols	50-55-0	50-55-0
Black soils	80-80-0	65-55-0
Grey Soils	50-55-0	55-55-0
Red Soils[2]	80-80-20	65-75-20
Brown Soils	55-50-0	55-50-0

Source: ADD/NFIU 1992.
Notes: [1]Nitosols and Andosols are the most important types of soils on which maize is grown.
[2]Red soils cover Nitosols, most Luvisols, and some Cambisols.

Increased fertilizer consumption translated into expanded number of fertilizer users as well as increased intensity of use by individual farmers. Between 1970-74 and 1991-95 fertilizer consumption in Ethiopia increased more than 10-fold. Nationally, the average dose of fertilizer was 35 kg/ha for all farmers (users and non-users) and 95 kg/ha for users in 1995/96 (Table 2.7)-- surpassing the average for SSA of 8 kg/ha (IFDC 1998). Ethiopia's intensity of use is still below that of Kenya and Zimbabwe, representative countries for Ethiopia due to their relative success in adopting high-input technologies. In Zimbabwe fertilizer use was at a high of 70 kg/ha in 1980, but fell to 53 kg/ha in 1995

[23]Soils in which maize and tef are grown contain the highest available potassium (K), with more than 60 percent of the soils containing over 300 ppm of available K (ADD/NFIU 1992). At 30 kg/ha, a negative maize yield response to potash (K_2O) was observed in Gojjam. In addition, the maize yield response to potash (K_2O) was low, about 3.5 kg/ha of grain per kg of fertilizer in Shewa and Sidamo (ADD/NFIU 1992).

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Table 2.7 Me

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(IFDC 1998). In neighboring Kenya fertilizer use also declined from 29 kg/ha in 1990 to 19 kg/ha in 1995 (IFDC 1998). Although the intensity of use in Ethiopia is growing, the level of use in 1995 remained below the average level of use for all of Africa of 21 kg/ha; 159 kg/ha in Asia; and 98 kg/ha in North America in 1995 (IFDC 1998).

Table 2.7 Mean Level of Fertilizer Use by Region, 1995/96

Region	Dose (kilogram/hectare)	
	Across All Farms	Users Only
Tigray	11	51
Amhara	22	75
Oromiya	47	100
Southern	47	126
National	35	95

Source: CSA 1995/96 in Demeke et al. 1998.

Overall, there is a potential to both increase the numbers of farmers using fertilizer as well as increase the intensity of use. Among the farmers that do use fertilizer, many use sub-optimal doses. Application rates are well below the recommended levels of 100 kg/ha DAP (46 kg/ha P_2O_5 and 18 kg/ha N) and 100 kg/ha urea (46 kg/ha N). However, there was significant regional variation in fertilizer intensity. The regions of Harar and Addis Ababa used the highest average level of fertilizer, but as mentioned earlier these regions are not characteristic of rural Ethiopia due to the high degree of urbanization. Excluding these regions, the Southern Region used fertilizer most intensely at 126 kg/ha, followed by Oromiya at 100 kg/ha, and Amhara at 75 kg/ha (Table 2.7).

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2.6 Profitability of Fertilizer

Introduction of high-input technology to Ethiopian farmers on a broader and more intensive scale is only a viable option to increasing agricultural productivity if input use, particularly fertilizer, is profitable. Profitability of fertilizer in Ethiopia is defined by the interaction of the agronomic response rate of fertilizer and the input-output price ratio. Common measures of fertilizer profitability are value cost ratios, the marginal rate of return, and a financial analysis of net income and returns to land and labor from adoption of fertilizer. This section reviews several studies that have estimated the profitability of fertilizer using different methods. A value/cost ratio[24] (VCR) or a marginal rate of return[25] show whether the "financial returns for the yield maximizing dose of fertilizer exceeds the costs of the fertilizer treatment" (Yanggen et al. 1998:31). VCRs take into consideration both the physical response and output and input prices. "Many observers contend that the marginal agronomic response must be at least twice the nutrient-to-grain price ratio for significant adoption to occur" (Heisey and Mwangi 1997:199). This translates into commonly accepted guidelines that provide an incentive for fertilizer use by farmers: a VCR equal or greater than 2 and a marginal rate of return of 100.

However, in theory, if the incremental value of production exceeds the cost of fertilizer, then fertilizer use will be profitable. "The rules-of-thumb requiring that the value

[24]Value-cost ratios are defined as the net revenue from fertilizer use (output price*the fertilizer response rate) divided by the price of fertilizer.

[25]Marginal rate of return is defined as the ratio of the additional net benefit to the additional costs resulting from the adoption of increasing levels of inputs (Crawford and Kamuanga 1988).

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of the yield increase be at least two times the fertilizer cost is a convention used in the fertilizer literature to allow for factors which affect farmers' input decisions but are not easily quantified--farmers' risk attitudes, on-farm yields that are lower than agronomic trial yields, or high yield variability due to climate, for example" (Yanggen et al. 1998:31).

Probably the most favorable estimates of profitability come from trial data estimated by the ADD/NFIU. Estimated VCRs for maize across Ethiopia are all above 2, ranging from 2.8 to 5.3 (Table 2.8). The estimated net yield increase for maize from the fertilizer trials under the ADD/NFIU recommended dose ranged from 1,268 in Shewa/Gojjam with black soils to 1,855 kg/ha in Wellega/Kefa/Illubabor with any soil type (Table 2.8). The incremental profit rates were also high--up to 892 Birr/ha in Wellega/Kefa/Illubabor.

According to these estimates, fertilizer use on maize is profitable across Ethiopia. However, caution must be extended when making policy recommendations from trial data. These estimates may be overestimated for many reasons, one of which is that the average control plot yields were higher than the national average. The average yield of control plots of 262 maize trials was 2,516 kg/ha which was 46 percent higher than the national average yield of 1,694 kg/ha for the period 1988-1991 (ADD/NFIU 1992). This difference is probably attributed to the use of improved seed varieties and row planting.

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Table 2.8 Results of ADD/NFIU Maize Trials

Zone	Soil Type	Control Yield (kg/ha)	Recommended Dose N (kg/ha)	Recommended Dose P_2O_5 (kg/ha)	Yield Increase[1] (kg/ha)	Profit (Birr/ha)	VCR
Shewa/Gojjam	Black	3,333	85	81	1,268	534	2.8
Shewa/Gojjam	Gray	2,734	57	58	1,490	766	4.8
Shewa/Gojjam	Red[2]	2,576	85	90	1,734	822	3.7
Shewa/Gojjam	Brown	2,278	58	55	1,578	832	5.3
Across the Country	Black	2,603	64	56	1,142	532	3.5
Across the Country	Gray	2,734	57	58	1,490	766	4.8
Across the Country	Red	2,454	66	79	1,493	719	3.9
Across the Country	Brown	2,273	58	53	1,560	824	5.3
Wellega/Kefa/Illubabor	all colors	2,641	90	90	1,855	892	3.8
Gamo Gofa/Sidamo	all colors	2,179	46	64	1,212	597	4.1

Source: ADD/NFIU 1992.
Notes: [1]The increase in yield due to nutrient application.
[2]Red soils cover Nitosols, most Luvisols, and some Cambisols. Most maize is grown on Nitosols.

Relative to the trial estimates, Demeke et al. (1998) presented discouraging results of the profitability of fertilizer use on maize following liberalization of the input and output markets in the 1990s. VCRs were calculated given the 1992 (before input market liberalization) and 1997 (after liberalization) input and output prices, but holding the level of fertilizer use constant at the ADD/NFIU recommended rates across the two years. During this period the input/output price ratio declined as a result of the increase in input prices outweighing the rise in grain prices.[26] Across the country, fertilizer prices increased from 21 to 39 percent as a result of the removal of the subsidies and pan-territorial pricing (Negessa and Jayne 1997).

[26]These VCR calculations used grain prices immediately following harvest in which prices are at their seasonal low.

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Maize
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GamuGofa Sidamo
Other
Across the Country

Source: Demeke et a

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Results showed that fertilizer profitability at the ADD/NFIU recommended fertilizer rates fell sharply between 1992 and 1997. These results indicated that the profit maximizing fertilizer doses in 1997 were considerably lower than the profit maximizing doses in 1992 (Demeke et al. 1998). Between 1992 and 1997 VCRs for maize fell on average from 3.97 to 1.32. For example, the highest VCR listed for maize, in Shewa, fell from 4.44 to 1.48, a decline of nearly 50 percent (Table 2.9). Overall, in 1997 VCRs fell below the cutoff of 2 for the majority of the site/crop combinations (Demeke et al. 1998). Barley was the most robust crop with respect to changes in input and output price, followed by wheat, maize, sorghum, and tef.

Table 2.9 VCR Comparisons for Maize and Tef, 1992 and 1997

Crop/Zone	1992			1997			
	Fert Cost (Birr/ quintal)	Output price (Birr/kg)	VCR	Fert Cost (Birr/ quintal)	Incremental yield with fertilizer (kg/ha)	Output price (Birr/kg)	VCR
Tef							
Shewa	211.67	1.22	3.69	515.86	641	1.35	1.67
Gojam	197.26	1.22	3.66	480.48	592	1.35	1.66
Arsi/Bale	160.39	1.22	3.60	390.54	473	1.35	1.63
Other	91.98	1.22	2.59	222.60	195	1.35	1.18
Across the Country	192.25	1.22	3.74	468.42	590	1.35	1.69
Maize							
Shewa	193.77	0.65	4.44	471.98	1,325	0.53	1.48
Gojjam	295.90	0.65	4.24	720.00	1,932	0.53	1.41
Welega/Kefa/ Illubabor	314.10	0.65	3.84	765.00	1,855	0.53	1.28
GamuGofa/Sidamo	190.60	0.65	4.13	463.36	1,212	0.53	1.38
Other	131.83	0.65	2.93	322.78	594	0.53	0.97
Across the Country	216.08	0.65	4.24	526.08	1,410	0.53	1.41

Source: Demeke et al. 1998.
Note: The fertilizer cost in 1992 and 1997 was calculated by multiplying the recommended fertilizer doses for each crop and zone (recommendations will vary) by the going fertilizer price in that year and zone. Thus across years, the fertilizer price changes but the recommended dose is held constant.

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Year	MOA/SG participants
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Source: Howard et al. 19

The value cost ratio is a useful tool to use as an indicator of the profitability of fertilizer, but it is by no means an inclusive measure of all the costs included in fertilizer use, and therefore a poor guideline for policy recommendations. The most important limitation of the VCRs is that it does not take into account the additional indirect costs of increased weeding or harvesting labor from increased fertilizer use, or increased marketing costs--factors that raise the price paid for inputs and reduce the price received for grain sales. In addition, the rule of thumb of 2 for a "profitable" VCR is not very useful because it is an arbitrary guideline, set to cover unidentified costs. An improved measure of profitability is a farm-level financial analysis of net margin (which includes the value of family labor).

Estimates of the profitability of fertilizer from SG farmer-managed plots is an improvement over the government trials; however, they too may overestimate the profitability of fertilizer use. Maize yields ranged from 2.8-3.8 MT/ha for relatively low-input technologies (local seed varieties, some DAP, no urea) on plots managed by the SG participants in the two zones of Jimma and Woliso (Table 2.10). This dramatically exceeded the national average of 1.9 MT/ha and the Oromiya Regional average of 2.1 MT/ha (where 49 percent of households use fertilizer).

Table 2.10 Maize MOA/SG Yields, MT/ha

Year	MOA/SG participants	MOA/SG graduates using high-input technology	MOA/SG participants using low- input technology	National average	Oromiya regional average	Potential yields on trials
1998	5.5	5.8-6.8	2.8-3.8	1.9	2.1	9-10

Source: Howard et al. 1999.

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The Sasakawa-Global 2000 (SG) program had resounding success in raising net incomes and returns to labor for its maize and tef technology packages (improved seed and fertilizer) in the Jimma, West Shewa, and East Shewa Zones of the Oromiya Region (Howard et al. 1999). The additional yields from the SG input package outweighed the additional costs of the high-input technologies of improved seed and fertilizer. Returns to family (immediate and extended) labor far exceeded average daily labor rates (3-6 birr per day) for all SG survey areas (Howard et al. 1999). At January 1998 prices (immediately following harvest) the returns to labor day were 15 Birr/day on program plots compared to 11 Birr/day on traditional plots (with local seed, DAP) managed by the same SG participants (Howard et al. 1999). The mean net income for maize for the SG current and graduate plots (many of which continued to use the SG technology under the NEP) was roughly double that of a "traditional" plot (Table 2.11). Even at all yield terciles, the net income for the plots with SG technologies far exceeded net income with the "traditional" inputs (Table 2.11).

The SG package thus far reported included improved seed and fertilizer; however, fertilizer alone, without the improved seed, can also raise net income and returns to labor. Net income for the low-input, local seed, no fertilizer package was 597 Birr/ha (not shown in table 2.11) compared to 1,030 Birr/ha for the local seed, 103 kg/ha DAP application ("Traditional" plot) (Howard et al. 1999). Returns to labor also increased, from 8 to 11 Birr/labor day with the introduction of fertilizer (Howard et al. 1999).

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Table 2.11 Net Income for Maize Farmers in Jimma, Birr/ha at January 1998 Prices

	Yield Terciles			
Program Type	1	2	3	Mean
Current SG program plot	1,385	1,963	2,757	2,044
SG graduate plot	1,740	2,627	3,257	2,543
"Traditional" plot	459	933	1,667	1,030

Source: Howard et al. 1999.

Note: Yields are ranked in ascending order and split into three equal groups, a third of farmers in each group.

2.7 Conclusion

This chapter demonstrated that introducing fertilizer to smallholders in Ethiopia is a feasible avenue to increased agricultural productivity. On-farm trials demonstrated that fertilizer can contribute to significantly higher yields for maize, but it must be remembered that profitability is a function not only of the fertilizer response rate but the current levels of input and output prices. The combination of three factors will determine whether farmers adopt the high-input technologies. The following chapters will show how the organization of inputs markets determines the shadow cost of purchasing inputs, particularly fertilizer, and ultimately, determines the pace of agricultural intensification.

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CHAPTER 3

STRUCTURE

The structure of a market is expected to influence the competitive conduct of sellers and buyers in the market, which in turn influences how well the market performs. "Market structure refers to the organizational characteristics of a market that largely determine where it falls in the competitive spectrum between monopoly and competition" (Marion 1986:210). Market structure is the framework within which firms operate. Key influences of market structure include concentration (the number of buyer and sellers), product differentiation (the extent to which a seller has some degree of independence in pricing and other marketing decisions (Staatz 1996)), barriers to entry and exit, and degree of conglomerateness. These elements of structure are outcomes of the regulatory environment in which firms operate. In sum, "structure refers to the sources of discretionary economic power that firms in the industry can exercise" (Staatz 1996). This research examines the key factors underlying the structure, conduct, and hence performance of the fertilizer market.

The structure of any market is shaped by two key factors: consumer preferences and market regulation ("rules of the game") (Rubey 1995). In Ethiopia, as will be shown, consumer's demand for credit and government policies played an important role in shaping the structur

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the structure of the market. This chapter focuses on the role of government which is inextricably tied to defining the opportunity sets available to all participants in the Ethiopian fertilizer subsector. The following sections outline the basic conditions that influence market structure and then describe the structure of fertilizer imports and the process of distribution.

3.1 Basic Conditions

In order to understand market structure, it is important to step backward for a moment to review the influences of structure, the basic conditions of a market. Basic conditions are the "underlying characteristics of the product and the environmental setting that help to shape the type of market that evolves for the product (Staatz 1996).

As in other SSA countries, fertilizer is a low margin, high-risk product: transport costs are high because fertilizer is bulky and distances are great, and risks are high in investing in fertilizer due to seasonality of demand, storage costs, and interest incurred. Due to these factors and due to the political importance (ultimately for low, stable urban food prices) of the provision of low-cost and stable fertilizer prices has usually meant heavy government intervention in setting prices and organizing distribution. Another plausible reason for government intervention in the fertilizer sector is the premise that rent-seeking behavior of middlemen would cause prices to rise if the government pulled out. However, this has not yet been proven to be the case under open markets.

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The seasonality of demand is basic condition that plays out in shaping market structure. Fertilizer is consumed primarily during the larger, *meher* season (roughly July to November), but also during the earlier *belg* (April to July). Most fertilizer is actually applied between March and July. To exacerbate the issue of seasonality, the port of Assab (the only port of import before the conflict with Eritrea in May 1998 forced imports through Djibouti) is limited in capacity. Thus not all fertilizer consumed in a given season could be off-loaded in the months immediately prior to distribution. Thus, coordination of imports was required in order to ensure sufficient fertilizer supplies.

Another basic condition that can influence the structure and performance of the fertilizer subsector is that fertilizer is easily adulterated. Fertilizer is sold in bags by weight and therefore it is possible for added impurities such as sand or dirt to go undetected before a sale. Thus, the nature of the transaction between farmer and supplier must be through trust and this may create a barrier to entry to potential entrants. Thus, established suppliers or larger companies backed by the government (assuming trust in government) may have an advantage in a market in which they have a presence.

3.2 Regulatory Environment

In Ethiopia in 1998 there was a heavy presence of government at every stage of the fertilizer subsector. All commercial fertilizer was imported and channeled primarily into government-controlled credit (and fertilizer retail/distribution) programs, very little was sold on the open market (on cash). The government controlled access to forex for imports as well as the timing of access to forex. The government (primarily regional government

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governments) also controlled which distributors could distribute through its fertilizer credit programs. Government provided credit to farmers primarily for the National Extension Program (NEP) through the district Bureaus of Agriculture, and to a lesser extent, to farmer Service Cooperatives (SC) for the regular credit program. Regular credit is defined as credit that had been historically channeled through SCs for fertilizer purchases by farmers prior to the expansion of the NEP. NEP credit was extended to participating farmers for the extension package of fertilizer, improved seeds and sometimes pesticides.

The fertilizer market is highly vertically integrated: 5 of the 7 integrated retailers are also importers. Wholesale transactions were made either from importer/integrated retailers to the 2 wholesalers or to independent retailers (who sell only in the open market and do not have access to the government input/credit programs). Retail transactions occur primarily from the integrated retailers, through the NEP and SC credit programs to farmers or by independent retailers to farmers.

Farmers thus primarily received inputs as a result of wholesale transactions between the government and large-scale suppliers and not through individual cash purchases. Consequently, the cash market was underdeveloped and in some areas suppressed by the government. In 1998 cash sales were directly and indirectly influenced by the regulatory environment, particularly the organization of credit. The volume of open market (cash) sales was highest in areas where the government credit programs were not meeting the needs of farmers or where the credit programs were absent (GMRP

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1998). The next two sections provide detail of how the government was instrumental in shaping the fertilizer market at all stages of the subsector in 1998.

3.2.1 Regulatory Environment of Fertilizer Imports

Before the Transitional Government of Ethiopia (TGE) came to power in 1991 fertilizer import was the sole responsibility of the government parastatal, the Agricultural Inputs Supply Company (AISCO) (later renamed the Agricultural Inputs Supply Enterprise (AISE)). Private trade in fertilizer was illegal. Since then, the Federal Democratic Republic of Ethiopia (FDRE)[27] opened imports to private companies, but the process of obtaining foreign exchange is still controlled by the government.

Allocation of Foreign Exchange. The current organization of fertilizer imports is largely shaped by the World Bank National Fertilizer Sector Project which began in February 16, 1996. The project involves provision of hard currency for imports in exchange for fertilizer sector policy reforms. The FDRE complied with the requirements: subsidies were removed, prices were deregulated, and private sector importers were granted "equal"[28] access to hard currency. Foreign exchange for fertilizer importers is thought to be allocated among the five "private" fertilizer importers (there were zero importers in 1991) and the parastatal on a competitive basis and in a very transparent way

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[27]The government changed names in August 1995.

[28]One importer reported in 1998 that it was required to provide a higher percentage collateral for hard currency for fertilizer imports than other importers (GMRP 1998).

(Sodhi 1999). All fertilizer importers use their own credit facilities to provide the local currency equivalent to the import value before they are allocated foreign exchange.

The FDRE primarily relies upon multilateral and bilateral donors for foreign exchange for fertilizer imports although it also annually allocates a portion of its own foreign exchange for imports. Supporting donors in 1998 included Japan, EU, Italy, FDRE, Netherlands, World Bank (IDA),[29] and Germany. From the inception of the World Bank project to mid-1999 the government financed 31 percent of the total value of imports, the World Bank financed about 15 percent, and other donors financed about 54 percent (Sodhi 1999). By early 1999 The World Bank total disbursements summed to US$42 million (Sodhi 1999). The closing date for the World Bank project was scheduled for December 31, 2000, however, and as of mid-1999 there were plans to extend this date. When the project draws to a close, the FDRE will have to find an alternative source of foreign exchange resources to continue importing at its current level (Sodhi 1999).

Dependency on donor funds influences the organization of imports in several respects. Fertilizer imported through donor funds is often conditioned: the quantity, source of supply, type of fertilizer, and port of entry may be specified. The timing of imports is also influenced by donors. Foreign exchange tenders are only offered when funds are made available, often at unspecified times of the year.

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[29]Standard IDA credit terms include repayment of the principal in 40 years, with a grace period of ten years and an annual service charge of 3/4 of 1 percent, plus an annual commitment charge (to be determined annually by IDA) not to exceed ½ of one percent (Sodhi 1999).

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The low lot size of fertilizer tenders is another key characteristic of the organization of fertilizer imports. Lot size has been constrained by two factors: port capacity[30] and the value of foreign exchange provided by donors. The donors provide funds independent of one another and are constrained by their own budgets. Thus tenders are offered based upon the amount of funds available at a particular time by one donor. Overall, the administrative costs per metric ton imported could potentially be reduced with larger shipments (see chapter 7 on performance).

The established importers (they must have proven access to capital) are alerted to when a fertilizer tender is open and all companies are expected to submit a bid. The requirement for winning a tender for fertilizer imports is the lowest price (no quota is in effect). A bid bond worth 2 percent of the value of the minimum lot of 25,000-30,000 MT is required. In addition, after winning a tender, a company must open a Letter of Credit with an Ethiopian bank in order to receive the hard currency equivalence of the value of imports to pay the international supplier.

This system of foreign exchange allocation for fertilizer imports contrasts with the freedom of fertilizer import found in most other countries. In Ethiopia foreign exchange allocation for fertilizer is tightly controlled by the government, however, all other imported commodities in Ethiopia use foreign exchange that is purchased in established weekly auctions. This in contrast to Kenya where fertilizer is treated no differently from other commodities. Another difference from Kenya is that in Ethiopia the FDRE does not

[30]The port capacity at Assab is limited to 30,000 tons (prior to the conflict with Eritrea all fertilizer arrived through Assab).

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Due to heavy involvement of the state and the dependence upon donors, the process of fertilizer importation is lengthy. In 1998 the time between entering a bid for foreign exchange and off-loading fertilizer may be 3 months. A fertilizer tender is floated for one month in which all importers participate, it is another 2 weeks until the winner is known, an additional 2-3 weeks to open a Letter of Credit, and an additional 1-2 months before the fertilizer arrives. It is stated that, on average, a ship is at port for 20 days, but it can take up to 45 days to get fertilizer off-loaded. One importer was able to get its supplies out of the port within 3 weeks which was considered a "fast operation" (GMRP 1998). Overall, fertilizer importers are required to estimate world prices up to roughly two months in advance. During this time, world prices may change, but also the cost of transport in Ethiopia can vary considerably due to the poor road conditions during the rainy season. In addition, importers carry the burden of interest on their loan (see chapter 7).

Under the FDRE's import "liberalization" policy, the number of importers increased from one to five. The first company to enter the import business was Ethiopia Amalgamated Ltd. (EAL), a private company. In 1995 it imported for the first time since the beginning of the military regime in 1974. A year later in 1996, Ambassel Trading House Private Limited entered the market. It is labeled a private company by the FDRE, but is owned by the Amhara Regional Government (and up until 1999, sold only in the Amhara Region). In 1998 two more companies began to import: Fertiline, a private company, and the other, Guna, owned by the Tigray Regional Government and operational only in Tigray.

Since the liberalization of fertilizer imports, AISE (the former input/output parastatal) has remained a prominent importer. In 1998 AISE was the largest importer, importing 50 percent of DAP imports in 1998 and 38 percent of urea imports (Table 3.1). Ethiopia Amalgamated Ltd. (EAL) is the second largest importer of DAP with a share of 19 percent. EAL did not import any urea in 1998 due to large carry-over stocks. In 1998 Ambassel, Guna, and Fertiline gained a small share of imports at 16, 13, and 9 percent, respectively.

Table 3.1 DAP and Urea Imports by Importer in 1998, MT

	DAP		Urea		Total	
Importer	MT	percent share	MT	percent share	MT	percent share
AISE	144,371	50.2	35,437	37.5	179,808	47.1
Ethiopia Amalgamated Ltd.	56,000	19.4	0	0	56,000	14.6
Ambassel Trading House	42,000	14.6	19,000	20.1	61,000	16.0
Guna	25,000	8.7	25,000	26.5	50,000	13.1
Fertiline	20,000	6.9	15,000	15.8	35,000	9.2
Total	287,371	100.0	94,437	100.0	381,808	100.0

Source: NFIA 1998.

With the exception of 1997, the share of imports to AISE in 1998 was declining. In 1995 AISE imported 81 percent of fertilizer imports, 65 percent in 1996, 100 percent in 1997 and down to 47 percent in 1998 (Table 3.2). There was a large carry-over of fertilizer supplies from the 1996 season, so fertilizer imports in 1997 were unusually low.

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Table 3.2 Total Quantity of Fertilizer Imported by Company, 1995-1998

Year	Agricultural Inputs Supply Enterprise (AISE)	Ethiopia Amalgamated Ltd.	Fertiline	Ambassel Trading House	Guna	Total, MT
	Percent of Total for Each Year					
1995	80.7	19.3	0	0	0	287,619
1996	64.8	27.9	0	7.2	0	338,780
1997	100.0	0	0	0	0	160,000
1998	47.1	14.6	9.2	15.9	13.0	381,808

Source: NFIA 1998.

3.2.2 Regulatory Environment of Fertilizer Distribution

As with imports, prior to 1992 the state-owned parastatal, AISCO controlled the fertilizer market. In 1992 the government developed the New Marketing System (NMS) with the primary objective of liberalizing the fertilizer market and creating a multi-channel distribution system (Demeke 1995). By 1998, the structure of fertilizer distribution in Ethiopia was shaped by two government programs, the National Extension Program(NEP) and the Regular credit program.

Credit. In 1997 it was estimated that roughly 80 percent of fertilizer consumed in Ethiopia was advanced to farmers on credit by government institutions responsible for distribution of both fertilizer and credit (Demeke et al. 1997). Therefore, how credit is organized is critical to understanding market performance--namely, whether credit availability meets demand, the timeliness of fertilizer delivery, and the profitability of investing in fertilizer at the farm, wholesale, and retail levels. Private fertilizer distributors were bound to government policy if they wanted to sell on formal credit to farmers because many farmers could not afford fertilizer without credit and in some areas the cash market was

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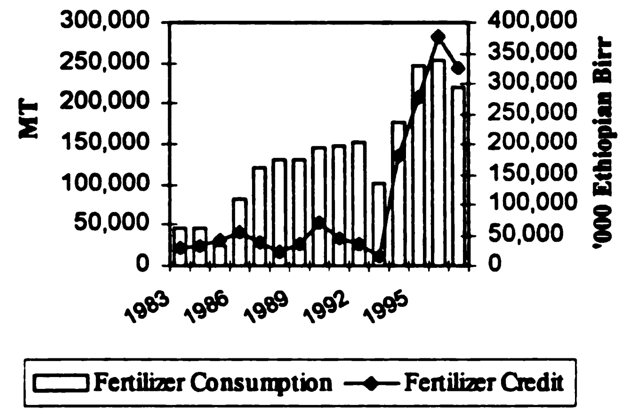
market was actively discouraged by the government (discussed further in section 3.2.3 and chapter 4).

In the early 1990s, the FDRE held primary responsibility for allocation of agricultural credit in a partnership between AISCO and the Agricultural Industrial Development Bank (AIDB).[31] Credit was channeled from the banks to the 2,900 Service Cooperatives (SCs) and member peasant associations (PAs). The SCs were responsible for the loan and therefore, also for screening member farmers. The loan was approved by the Wereda Agricultural Bureau and then signed between the AIDB and the SC. The SC signed a loan agreement between the bank and the SC. The SCs then charged the farmers a premium over the loan rate provided to the SC by the banks. However, in 1998, with the exponential expansion of the NEP and the low repayment record of the SCs, many SCs were no longer permitted to receive input credit for their members. By 1998, the Bureaus of Agriculture were responsible for the administration of credit and fertilizer distribution.

Poor loan recovery became an increasing problem in the early 1990s. During the late 1980s the recovery ratio was roughly 80 percent; however, the rate fell to 54 percent in 1990; 37 percent in 1991; and 15 percent in 1992 (Demeke 1995). Part of the reason for the low recovery rate was the collapse of SCs after 1991 with the overthrow of the military government. The institutional vehicle for collecting loans had collapsed and the

[31]The Commercial Bank of Ethiopia (CBE) extended some loans in 1986 and 1987 as a temporary measure but did not become fully involved until 1993.

Figure 3.1 Fertilizer Credit and Consumption, 1983-1997
Source: NFIA, 1983-1997



government was not prepared to take its place. In the early 1990s the government stepped in to reverse this trend and promote expanded rural input credit. In 1992 the AIDB was absolved of its massive defaults and given a clean slate. It was renamed the Development Bank of Ethiopia (DBE) which, together with the Commercial Bank of Ethiopia (CBE), extended smallholder fertilizer credit. Between 1993 and 1994 the amount of credit extended to farmers increased 10-fold (Figure 3.1). This probably contributed to the sharp increase in fertilizer sales in 1994 but also helps explain the poor recovery rate: farmers purchased more fertilizer on credit because they thought it was a gift from the government (Demeke 1995).

By 1996/97 the FDRE agreed to guarantee credit: the responsibility for credit disbursement and collection was transferred from the banks to regional governments.[32] The CBE and DBE extended credit as in the past, but in 1998 the government agreed to pay the banks the full amount of the loan in case of default. The risk of the loans was shifted to the regional governments. By the mid-1990s loan recovery improved considerably relative to the early 1990s. CBE reported a recovery rate of 92 percent in 1995/96 and 83 percent in 1996/97 (Demeke et al. 1997). DBE also reported a recovery of 95 percent and 87 percent during the same period (Demeke et al. 1997). When the regional governments took responsibility for credit, they took measures to enforce repayment through the threat of fines and imprisonment.

3.2.2.1 Organization of Fertilizer Distribution in 1998

The organization of the fertilizer subsector in 1998 changed markedly in some regions between 1997 and 1998 but key influences remained--the government controlled credit and "partystatals" (government-favored distributors) dominated some markets. Although there is some evidence of moving toward a more transparent, competitive fertilizer market in some regions in 1998, other regions remained monopolistic. In contrast, the fertilizer sector in all regions in 1997 was characterized by a high degree of market concentration where market shares of the six fertilizer distributors were directed by

[32] The margin of 4.5 percent, the difference between the 10.5 percent loan rate and the 6 percent savings rate was shared equally between the bank and the regional governments. Prior to 1998, the bank received the entire margin.

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In 1998, the market remained vertically integrated, importers were involved in retailing, but the degree of competition in the market increased marginally due to the entrant of a new distributor and the introduction of fertilizer auctions. Although fertilizer auctions were planned in several regions, policies were reversed in some areas and government-nominated companies were awarded the market. The responsibility of fertilizer distribution in Tigray was given to one distributor. Similarly, in the Amhara and Southern Regions one distributor held the responsibility to distribute fertilizer, but they invited other distributors to enter “their” markets as their stocks declined. These “partystatals” can supply the government credit/fertilizer programs (as do other large wholesalers), but in addition, they have preferential access to the services of local governments such as transport and access to warehouses owned by the government or SCs at subsidized or no cost (Demeke 1999).

Fertilizer auctions were instrumental in improving competition, particularly in the Oromiya Region. Participating retailers offered competing bid prices to distribute a specified type and quantity of fertilizer to a wereda. The auction is a departure from 1997 in which the fertilizer distributor for each wereda was assigned by the regional governments.

Another change in 1998 was that the fertilizer subsector saw a dramatic increase in the number of farmers participating in the National Extension Program (NEP). Fertilizer credit was extended through the NEP, and was available, but to a lesser extent, outside the exten

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extension program, in what was once the SC regular program credit. In 1998 there was a dramatic decline in the amount of credit extended to farmers outside the extension program. In fact, the regular program credit was dissolved in many weredas as the NEP expanded (and SCs defaulted on loans).

In 1998, the two input credit programs, the NEP and regular program credit, were administered separately. The primary difference, in general, between the two programs was that the NEP was administered (at least in Oromiya) by the Bureau of Agriculture and the regular credit program was administered by the local government administration. It is reported that, in general, the Bureaus of Agriculture were relatively transparent and fair compared to the local administration (Demeke 1999). As will be seen in the next chapter, the differences in administration may have an impact on the resulting efficiency and prices offered in the two programs.

In 1998, the degree of seller concentration in retail distribution at the national level was also highly concentrated and increasingly concentrated at the regional and zonal level. In 1998 nationally, there were 7 integrated retailers (AISE, EAL, Fertiline, Guna, Ambassel, Dinsho, and Guna–5 of which also imported); however, only one to three companies may have operated in any region (Table 3.3).

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ble 3.3 Percent of Regional Fertilizer Sales by Distributor, 1997

	Tigray		Amhara		Oromiya		South		Others[1]	
stributor	DAP	Urea	DAP	Urea	DAP	Urea	DAP	Urea	DAP	Urea
SE	36.2	29.4	0	0	44.9	49.6	83.0	94.2	37.7	49.7
L	34.6	36.0	1.2	0.1	30.4	17.6	17.0	5.8	45.2	41.8
nbassel	0	0	98.8	99.9	0	0	0	0	17.1	8.5
nsho	0	0	0	0	24.7	32.8	0	0	0	0
na	29.2	34.6	0	0	0	0	0	0	0	0
rcent	100	100	100	100	100	100	100	100	100	100

rce: NFIA 1998.

: [1]Includes Benishangul and Gumez, Somalie, Harar, Addis Ababa, Dire Dawa, and Gambela.

Primarily one company operated in Amhara; two companies in the South; and e companies in Oromiya and Tigray. In 1997 in Amhara, Ambassel supplied 99 cent of both the DAP and urea markets (Table 3.3). The South was also heavily centrated, with AISE supplying 83 percent of DAP sales and 94 percent of urea sales ble 3.3). The regions of Tigray and Oromiya were roughly split among three ributors: AISE, EAL, and Guna in Tigray, and AISE, EAL, and Dinsho in Oromiya ble 3.3).

In 1997 the integrated retailers varied in the degree to which they concentrated r operations in particularly regions. EAL and AISE had broad distribution networks-- plying most of the primary fertilizer consuming regions. Whereas Ambassel and Guna centrated their sales in Amhara and Tigray, respectively (Table 3.4).

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Table 3.4 Percent of Distributor Fertilizer Sales by Region, 1997

	AISE		EAL		Ambassel		Dinsho		Guna	
Region	**DAP**	**urea**	**DAP**	**urea**	**DAP**	**urea**	**DAP**	**urea**	**DAP**	**urea**
Tigray	3.9	7.3	6.8	18.7	-	-	-	-	100.0	100.0
Amhara	-	-	1.5	0.1	97.5	94.5	-	-	-	-
Oromiya	57.0	57.5	70.1	42.6	-	-	100.0	100.0	-	-
South	35.0	14.2	13.0	1.8	-	-	-	-	-	-
Others[1]	4.1	21.0	8.6	36.8	2.5	5.5	-	-	-	-
Total	100	100	100	100	100	100	100	100	100	100

Source: NFIA 1998.

Note: [1]Includes Benishangul and Gumez, Somalie, Harar, Addis Ababa, Dire Dawa, and Gambela.

Tigray Region. The organization of the system of fertilizer distribution in Tigray was more monopolistic than any of the other regions. In 1998 Guna, the regional government affiliated company, did not distribute fertilizer to Tigray as it had in the past. In 1998 the Tigray Regional Government asked three importers, AISE, EAL, and Guna, whether they should divide the region amongst themselves or issue tenders as in the Oromiya Region. The year earlier, 1997, Tigray divided the market between these three distributors, each supplying different weredas. When faced with an invitation to supply in 1998, EAL and Guna declined. Therefore, by default AISE was responsible for supplying the entire region, distributing 220,000 MT by August, 1997.

Amhara Region. Prior to 1998 the responsibility of fertilizer distribution in the Amhara Region was in the hands of several distributors, each with a roughly equal designated share of the market. However, by 1998 Ambassel, the regional government affiliated company, was the sole distributor in the region. In that year the Amhara

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Regional Government dismissed the central government proposal to hold fertilizer auctions and gave Ambassel exclusive distribution rights.

Two private companies, Ethiopia Amalgamated (EAL) and Fertiline, were told they were not permitted to participate in fertilizer distribution in the Amhara Region:

> In principle, the distributor selection should be made in bidding method. This was also confirmed by guidelines which were disseminated by the regional government to every Wereda Bureau. This was in vain. Reversely, the Regional Government was standing in favor of Ambassel, the only seller, rejecting other suppliers (GMRP 1998).

In Amhara, in 1998 the NEP was extensive: it was reported that most farmers were in the NEP (GMRP 1998). However, there were areas when the SC regular credit for non-NEP farmers was still available. Where the SC credit was not available, often the SCs were used by the NEP to facilitate the organization of credit and distribution of fertilizer. When the regular credit was available, the SC obtained credit from a lending institution called the SC Follow-up Bureau. The NEP obtained its credit from a separate institution, the Amhara Rural Credit Association.

In the NEP in general, whether a fertilizer auction or government-appointed market, the program required that fertilizer be distributed through the SCs or a retail outlet in rural areas. However, often the appointed distributor distributed fertilizer from its own warehouses (in the wereda capital–usually far from the rural SC) or else it delivered the fertilizer to the wereda Bureau of Agriculture whereby the Bureau often transported the fertilizer to the farmers (without compensation from the responsible dis

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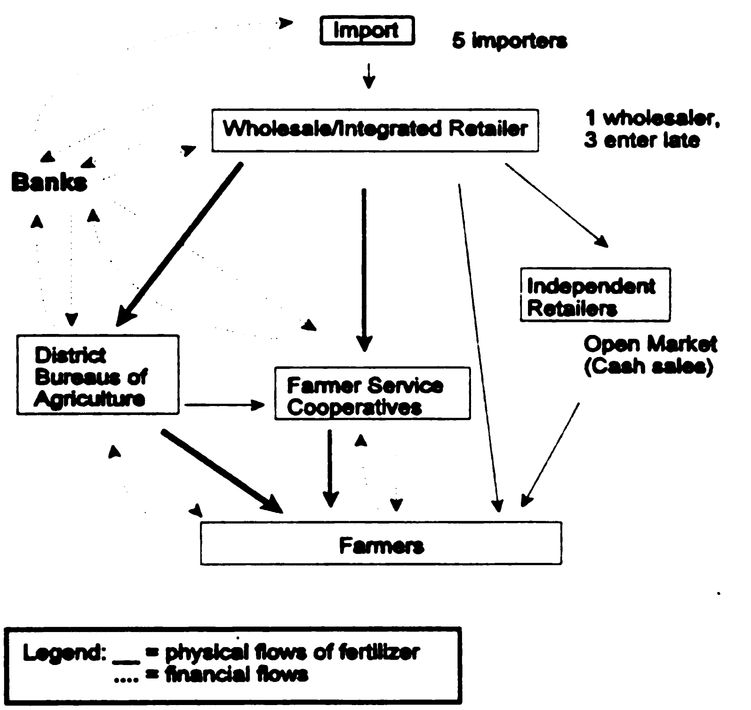
distributor). In Amhara, in particular, Ambassel was given the right by the regional government to use SC warehouses to stock its fertilizer.

For the SC regular credit program the SC received a 2 percent per annum interest rate, the remaining 10.5 percent was split between the banks and the regional government(interest rates were 10.5 percent/annum in the Oromiya and Southern Regions). The SCs take the down payment, along with a voucher from the Bureau of Agriculture directly to the designated suppler who then takes the voucher to the bank, receives payment in full, and then proceeds to distribute.

The open market in Amhara, as in all regions, was thin. The volume of fertilizer in the open market was highest in areas where the NEP was not meeting farmer demand for

Figure 3.2 Structure of the Fertilizer Subsector in Amhara in 1998



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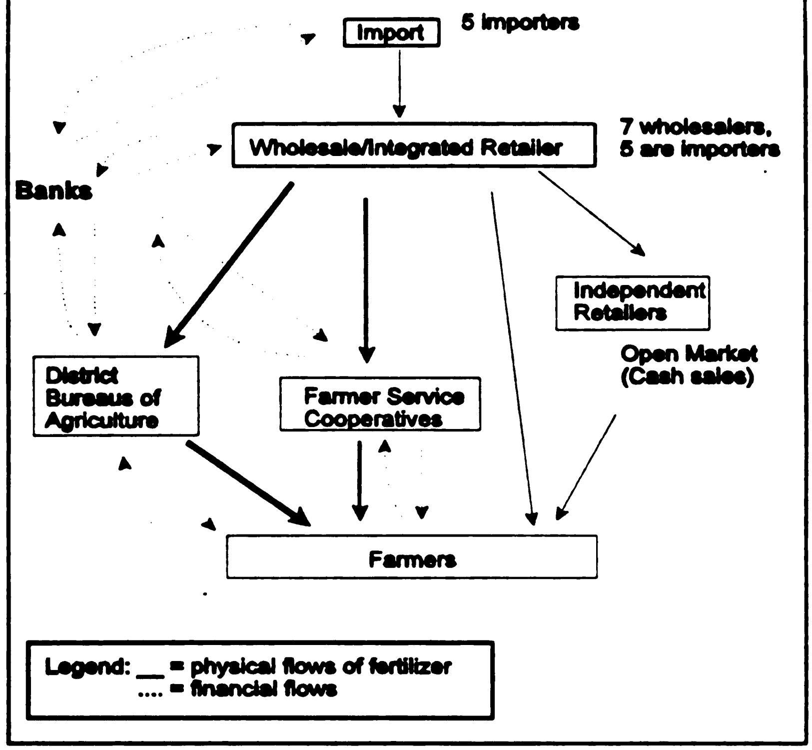
inputs or where the credit programs were absent. Independent retailers reported that government officials often threatened farmers to not purchase fertilizer from independent retailers, perhaps to encourage farmers to participate in the NEP (GMRP 1998).

Oromiya Region. The organization of the fertilizer market in the Oromiya Region has been in flux. Within a decade fertilizer supply shifted from a system of controlled prices and monopoly supply to relatively increased competition in 1998. In 1998 for the first time fertilizer auctions were held in which retailers competed on the basis of price for a given bid. Although more competitive than a government-appointed market, access to the auctions was not completely open, but controlled by the regional government. Four large importers were invited to participate: two private companies, EAL and Fertiline; AISE, the old government agricultural grain and input parastatal, and Dinsho, owned by the Oromiya Regional government. In 1997, a year before retail and wholesale fertilizer prices were fully "liberalized", three companies supplied Oromiya farmers: Agricultural Input Supply Company (AISE) (37 percent of the market), Ethiopia Amalgamated Ltd. (EAL) (33 percent of the market), and Dinsho Private Limited Company (31 percent of the market) (Demeke et al. 1998). These three companies had geographically separate markets, thus removing competition at the retail level. In 1997 credit was allocated to the designated distributor who was responsible for supplying a particular area. Therefore, if a farmer wanted to purchase fertilizer on credit, it was not possible for him or her to choose their source of supply. In 1997 farmers received credit through their SC which obtained a loan from a local bank.

Figure 3.3 Structure of the Fertilizer Subsector in Oromiya in 1998



In contrast to the Amhara Region, the regular SC credit program was relatively active in the Oromiya Region. As in the Amhara Region, the SC regular credit and NEP credit were organized by separate institutions. In 1998 the SCs received approval for credit from the regional government, but the administration of credit lay with the SC and banks, independent from the regional government. In contrast, in the Amhara Region farmer groups would not interact directly with the banks--the Wereda Bureau of Agriculture coordinated this stage of the process.

An illustration from the Oromiya Region provides a glimpse of the detailed procedures involved in administering the regular credit/fertilizer distribution program. Often administration of credit under the regular program was performed at different levels–

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levels--by the peasant associations (PA) and farmer associations (FA)--but ultimately responsibility lay with the larger SCs.[33] Members of a PA, FA, or SC, usually elected officials, collected last year's loan from farmers, screened farmer fertilizer requests for the upcoming season based upon ability to pay, and then collected the down payment for the new loan. The FA, PA, or SC assessed the amount of down payment the farmer could afford. A down payment of 25 percent was desired, but particularly poor farmers received 100 percent credit and many others received 90 percent credit. Once the demand estimate was gathered, it was forwarded to the Cooperative Promotion office (CPO) in the Wereda Bureau of Agriculture. The CPO and the Wereda Bureau of Agriculture Input Coordination Unit (ICU)[34] reassess the fertilizer demand requirements. The wereda ICU revises the fertilizer demand based upon the previous year's repayment record and the amount of credit allocated in the current year. The ICU then sends the demand estimates to the zonal level. Again the demand estimates may be revised before being passed to the regional level. It is at the regional level that the amount of credit to the region was confirmed and divided among the weredas and also divided between the extension and regular credit programs.

Once the quantity demanded was approved, the PA/FA/SC collected the down payment from farmers, delivered the down payment to the bank, and received a bank order

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[33]In some areas it is common that between four to six FAs or Peasant Associations (PA) make up one Service Cooperative. The FA or PA has roughly 200-300 members and is better suited to screen farmers than the SC which can have over 1,000 members.

[34]A committee of representatives from the Bureau of Agriculture, the Cooperative Promotion Office (CPO), local administration, and banks.

from the bank. This extra responsibility of the SC is not insignificant because often a trip to the bank requires a day of travel and involves transporting the cash down payment which risks robbery. Additionally, once the members of the SC (three SC officers were required) reached the bank they each started the paperwork as if for a personal loan, which may be excessive. Once the bank order is delivered to the distributor, the distributor may begin releasing its stock. After delivery the distributor receives a delivery order upon which presentation at the bank permitted the bank to pay the distributor in full.

For regular program credit, the FA/SC was told by the government that it must have 100 percent repayment in order for it to receive fertilizer on credit in the subsequent year. However, this percentage was relaxed in many cases. In effect, there was no uniform guideline of what percent default rate was permissible. Some SCs received credit with a 65 percent repayment rate whereas others with the same repayment rate did not. "Unsatisfactory" repayment rates meant the SC could not obtain credit the following season.

Southern Region. Similar to the Amhara Region, in the Southern Region one supplier dominated the fertilizer market in 1998. Fertilizer distribution for the early, *belg* crop was carried out by one distributor, Wendo, owned by the Southern Regional Government, but AISE was invited to distribute for the later, *meher* crop. When Wendo's supplies began to dwindle toward the end of July, after most of the fertilizer had been distributed for the *meher* season, the Southern Region issued tenders. AISE and Wendo were the only bidders and AISE won 80 percent of the tenders. There was speculation that AISE was able to bid because it had stock in the region, ready for distribution, but

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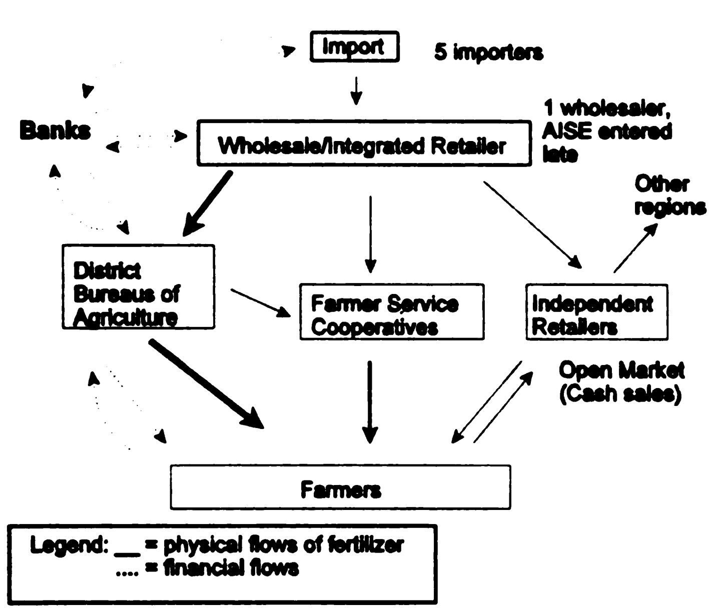
EAL, who wanted to participate, was not permitted because their stock in the region had expired and thus was no longer suitable for use (GMRP 1998).

In the South the Service Cooperatives were removed from the role of distributing fertilizer credit to farmers and remained active in the sector only because their warehouses were used by the government-appointed distributors for the NEP (often uncompensated).

The cash market in the South was very thin. There were reports that the warehouses of some independent retailers were locked by government officials in order to prohibit cash sales (GMRP 1998). Independent retailers in other regions called the Southern open market a "black market" (GMRP 1998). Many NEP participants in the South sold unwanted NEP fertilizer on the open market. Independent retailers trucked fertilizer out of the region, primarily to the East Shewa Zone in Oromiya Region where

Figure 3.4 Structure of the Fertilizer Subsector in the South in 1998



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there was an unmet demand for fertilizer (GMRP 1998). These open market cash sales were reported to undercut the sales of independent retailers in Oromiya (GMRP 1998).

3.3 Barriers to Entry

In Ethiopia real and perceived barriers (whether or not a manifest of government policies) to entry into the fertilizer market will contribute to the structure of a market. A barrier to entry provides incumbent firms in an industry an advantage over potential entrants. Four key barriers to entry are discussed here and shown how they may affect entry to the import and distribution market in Ethiopia. These entry barriers include an absolute-cost advantage, economies of scale, capital cost requirement, and strategic behavior barriers--all of which are influenced to some extent by government regulation described in the last section. Strategic behavior by incumbent firms (often government-affiliated firms) is a barrier to entry when it deters potential newcomers from entering the market. As will be seen, evidence in chapter 7 on input market performance reveals that there is a relationship between reduced barriers to entry, improved competition, and retail prices in the sector.

A capital cost barrier refers to the size of investment required for efficient entry. Fertilizer import tenders are issued in lot sizes ranging anywhere from 15,000-25,000 MT. Importers, therefore, must have access to a minimum amount of capital. Upon entering a tender an importer was required to provide a 2 percent bid bond and then, after the importer wins a bid, he or she is required to provide the full Ethiopian Birr value of the shipment (on credit) in exchange for US dollars.

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If a potential new entrant does not already have the capital available to submit a bid for import, he or she will face a search cost to find credit and may face higher rates than veteran borrowers. Thus, new entrants at the import stage may also face an absolute-cost disadvantage. An absolute-cost advantage barrier occurs when the unit cost of the incumbent firm for all levels of output is lower than that which can be achieved by a new entrant. No matter the volume of imports the incumbent firm will still face the fixed transaction cost of finding capital. The importers operating in Ethiopia in 1998 all had a credit history with the Ethiopian banks (because the companies were well established importers and obtaining foreign credit is illegal).[35]

Other evidence of an absolute-cost advantage is that, even if the independent retailers were permitted to participate in the fertilizer auctions, they may not be able to offer a competitive bid because the independent retailers purchased their fertilizer from the same integrated retailers that they would have to compete against in a bid. The integrated retailers have an absolute-cost advantage, they have access to lower cost inputs.

Economies of scale can be an important factor contributing to barriers to entry both at the import and distributions stages of the fertilizer subsector. Scale barriers exist if the minimum efficient scale of a plant or firm is large relative to the industry size and thus smaller sized firms (lower production capacity) are subject to significantly higher costs. Economies of scale may be a factor contributing to increased concentration. That is, the

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[35]Fertiline, who was a new importer in 1998, is a subsidiary of the Noble House and Trustworthy Private House Ltd. who has been importing consumer goods since 1991. Ethiopia Amalgamated Ltd. used to import fertilizer under the Imperial Government, but has imported a range of agricultural inputs in the interim.

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market is only large enough to support a few suppliers, each operating at their minimum average cost.

In Ethiopia, in 1998 several large firms were able to command a large portion of the market, not because they represented a natural monopoly in their regions and the market had determined the efficient (each operating at minimum average cost (AC)) number of firms, but rather, the government had determined which companies had market access. Thus, the number of firms was a function of government policy, not a function of the presence of economies of scale.

Figure 3.5 shows that average unit costs (AC) can be reduced with expanded output. Contrary to the typical U-shaped cost curves, under economies of scale costs first fall and then are constant over a large range of outputs. If several large firms exist in the market (as is the case in Ethiopia) and account for a large portion of the total market they each may be able to realize economics of scale and charge P_2 (where D_2 intersects the average cost (AC) curve). However, when a new firm enters the market, it will face a smaller market at D_1 and therefore, its output will be constrained and it will charge a higher, uncompetitive price, P_1. Thus, the structure of costs relative to market demand can serve as a barrier to entry. If a few large firms existing in a market can fulfill Ethiopia's fertilizer market at a lower cost than if there were a greater number of firms, each with a lower volume, then the incumbents will have a cost advantage, consumers will face lower prices, and the market will have a high level of concentration. At the distribution stage of the subsector economies of scale may be realized due to the high fixed costs of trucks, storage and market search costs.

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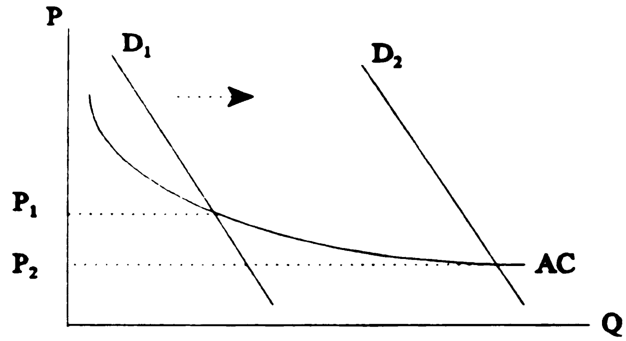
Figure 3.5 Economies of Scale and Market Demand



The presence of economies of scale can also explain why the level of demand is critical to providing low-cost fertilizer. For example, if demand was at D_1 then that quantity demanded would be insufficient to produce at a firm's average minimum unit cost (where D_2 intersects the AC curve). However, if demand shifts out with an increase in population (or due to the expanding NEP), for example, to D_2 then the price could fall to P_2 because the unit costs of the firm declined as output increased (Figure 3.5).

In Ethiopia the government also practiced strategic behavior in order to influence the market structure according to its interests. A firm's (or government's) strategic behavior can create a barrier to entry that deters new entrants at the retail level. Fertilizer distributors that are tightly connected to regional governments, such as Ambassel in the Amhara Region, can use aggressive tactics to deter new entrants into the business of fertilizer distribution, but also deter new competitors in a geographic area.

In 1998, the national and regional governments were very successful in their strategic behavior to influence targeted distributors and to shape markets according to

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their interests. For example, AISE was invited by the Southern zones to position supplies in the region (GMRP 1998). AISE acted fast, hoping to distribute the stock it imported to the region. However, when the fertilizer season arrived the regional government told AISE that there was a change in policy and Wondo was given the responsibility for fertilizer distribution. AISE waited roughly 8 months for permission to distribute its stock and finally did in August 1998, after most farmers had planted their crops. The cost to AISE was tremendous. The regional government may have used AISE's stock as a safeguard against the possibility that Wondo–its favored company–had insufficient supplies.

In 1998 in many areas the regional governments actively discouraged cash sales which threatened businesses of independent retailers who sold solely in the open market and were not permitted to participate in the government input credit programs. A factor that may have motivated the regional government's decision to restrict market participation of the independent retailers (those that are engaged only in cash sales at the retail level) may have been a fear that the "small" traders did not have the capacity to deliver the contracted amount in the credit programs, and therefore would have a higher probability of default than the larger companies. However, obtaining the necessary quantity of fertilizer to fill a bid was not a problem for some traders. The independent retailers surveyed across five zones in Oromiya sold from 40-3,000 quintals of DAP and from 20-205 quintals of urea, more than an average tender in the credit programs (GMRP 1998).

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3.4 Vertical Integration

Vertical integration may be a manifest of government input and credit policies. Vertical integration is an organizational market structure in which a firm remains the owner of a product over multiple stages of the subsector. The higher the degree of vertical control, the more degrees of freedom the firm has with respect to conduct (Staatz 1996). As a consequence of the national and regional government policies, in 1998 the Ethiopian fertilizer subsector was highly vertically integrated with all of the fertilizer retailers also acting as importers with the exception of Wondo and Dinsho.

The presence of vertical integration can reduce retail prices through cost-savings from reduced transaction costs and improved coordination at different stages of production. However, there also may be drawbacks to vertical integration. Vertical integration can remove the potential efficiency gain from specialization and gains from trade. One importer in Addis noted in 1998 that he entered the business of fertilizer importing with the intent to sell his stock at the port. To his surprise he was unable to sell his stock at the port and was instead strongly encouraged by the national government to enter fertilizer distribution at both the wholesale and retail levels. The unexpected plan to distribute may have meant the importer lost money in the market if he or she did not cover the start up costs involved in searching for a market, transportation, and storage, and also remain competitive.

The presence of integrated firms in a market may lead to reduced market competition. Independent retailers can not compete at the same level with the integrated firms because they purchase their inputs from the integrated firms. Thus the small retailers get sq

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get squeezed out of the market and the integrated firms gain a greater portion of the market. A few large integrated firms in the market can mean lower-priced fertilizer to farmers (through reduced transaction costs); however, due to their increased market concentration, the ability of these firms to raise prices above marginal cost may lead ultimately to higher prices for farmers.

3.5 Conclusion

This chapter demonstrated that the structure of the fertilizer subsector in Ethiopia in 1998 was characterized by a high degree of regional and national government intervention at every stage of the market, from import to retailing, as well as in both credit and open market cash sales. Government controlled which distributors could sell on credit and credit sales dominated the subsector. Thus how credit was organized shaped the profile of distributors--the number of distributors and their market share. Distributor access to credit for retail sales was tied to distribution through the NEP and regular credit programs. The small independent retailers that sold only in the open market did not have access to government-guaranteed credit.

The organization of credit influenced property rights, namely, which retailers had access to which markets. Thus, the organization of credit served as a barrier to entry to the market, if the trader was an independent retailer. However, larger, private integrated retailers (e.g., EAL, Fertiline) were also squeezed out of some credit markets by the government-favored "partystatals."

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The following chapter on market conduct will describe the chosen product and pricing behavior of firms in this environment. This research will then proceed to show the extent to which market structure influences conduct which, in turn, affects market performance.

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CHAPTER 4

CONDUCT

Market conduct refers to the patterns of behavior that enterprises follow in adapting to the markets in which they sell (Bain 1968). More specifically, market conduct "consists of a firm's policies toward its product market and toward the moves made by its rivals in that market" (Caves 1982:48). A firm's conduct is a reaction to the market structure and also a pro-active attempt to change market structure.

In theory, a benevolent market-oriented government would define the legal boundaries of market conduct in cases of price fixing, product labeling, and advertising claims. In this case, the government's primary objective is to support an environment that provided consumers with a low-cost, quality product, as well as provided input suppliers, manufacturers, and distributors with an "even" playing field. In Ethiopia, an important question is to what extent does the government protect and promote selected favored companies.

This chapter examines to what extent government's policy affects market conduct, as well as market structure. In the extreme, the government-controlled access to credit restricted access to regional retail markets. This chapter will outline the product and pricing strategies practiced by firms in the fertilizer subsector and how the government influence

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influenced these practices. The following chapter will use the observations of market conduct presented in this chapter to estimate an econometric hedonic price model in order to determine the determinants of spatial fertilizer price variation, with particular attention to the impact of different pricing mechanisms and distribution channels.

Two key issues of conduct are examined here: pricing behavior and product strategy (Caves 1982). Practices of coercion and entry deterrence are also examined--for they are the means to defining a firm's product and pricing options and ultimately its market share.

4.1 Pricing Behavior

Until 1998 fertilizer wholesalers in Ethiopia were more or less passive when it came to marketing strategies. They had little option but to accept the government's selling price and in addition, their market share was also often defined by the government. In 1998 for the first time, with the liberalization of prices, fertilizer distributors found that they had a range of potential marketing options. However, in 1998 this freedom in market conduct was unexpectedly constrained by government policies that either forced firms out of the market entirely or thwarted plans to secure a market. Hence, decontrol of fertilizer prices coincided with greatly increased government control over the conduct of private firms in the fertilizer market.

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4.1.1 Pricing Behavior--Background

In 1998 for the first time in Ethiopia's history the government was not involved in setting fertilizer prices. During the Imperial Government and throughout the military regime of the Derg, the Ethiopian Government set pan-territorial and generally subsidized fertilizer prices (Table 4.1). The objective of the fertilizer policy was to ensure low, stable, uniform prices. Prices were calculated by government, based upon a c.i.f. value on the international market, handling charges, and internal transport costs.

Table 4.1 Government Fertilizer Retail Prices, Birr/Quintal

Year	DAP	Urea
1982-91 average	85.22	68.52
1992	107.10	95.30
1993 (subsidized price)	149.80	132.80
1994 (subsidized price)	143.35	131.15
1995	178.00	168.00
1996	200.00	190.00
1997	govt. set prices for 150 wholesale/retail markets	
1998	decontrolled	decontrolled

Source: NFIA 1998.

In 1991 after the overthrow of the military regime, the FDRE made a declaration to decontrol the input market. However, liberalization in effect was slow to emerge. From 1992 to 1996, retail and wholesale prices remained subsidized and pan-territorial. Competition increased at the retail level but the distribution margin set by the FDRE did not cover more than 20 kilometers from primary marketing centers and therefore served as a disincentive for private traders to serve the more remote areas.

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In February 1997 retail prices were liberalized, but wholesale prices remained administered. Wholesale prices were calculated by the government for 150 wholesale centers in the regions of Tigray, Amhara, Oromiya, and SNNPR based upon a weighted average of carryover stock and new imports in 1997. As a result of decontrol, fertilizer retail prices increased by more than 25 percent in 1997 due to the removal of implicit subsidies (Demeke et al. 1998). Consequently, it is reported that in 1997 fertilizer use fell by 20 percent due to the removal of the implicit subsidy as well as due to credit restrictions on defaulting farmers (FAO/GIEWS 1998). It was not until the 1998/99 cropping season that both retail and wholesale prices were liberalized.

4.1.2 Price Determination in 1998

Following the liberalization of retail and wholesale prices in early 1998, a variety of distinctly different fertilizer market pricing mechanisms emerged in the three regions of Amhara, Oromiya, and Southern--varying from monopoly markets and fertilizer auctions for credit sales, to open market arrangements through cash sales. Although the government did not directly intervene to set prices, most areas of the country were still heavily influenced by government regulation. Most fertilizer was sold on credit and channeled through institutions heavily influenced by the FDRE, namely the NEP and regular credit programs (through Service Cooperatives).

In many areas of the country the government nominated a fertilizer supplier and privately negotiated a retail price for the NEP and regular credit programs for a known quanti

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quantity of demand. In other areas, 3-5 wholesalers placed bids in a fertilizer auction for rights to supply a known quantity of demand in the NEP and regular credit programs.

Overall, prices were considered to be competitively determined in the residual open (i.e., cash) market, but in some areas of the country the cash market was actively suppressed by regional government influences. Both the large wholesalers and the independent retailers competed in the open market. Therefore, if the independent retailer was purchasing his/her supplies from the wholesaler then he/she may not have been able to compete in the retail market if the wholesaler decided to sell directly to farmers in the cash market as well.

Due to the different pricing mechanisms present in the country, retail prices were predicted to diverge by varying degrees from the competitive equilibrium. Economic theory indicates that a monopolist will set output at Q_1 (where marginal cost=marginal revenue) and price at P_1 (the demand for Q_1), and under perfect competition, prices will be lower, at P_2 (where marginal cost=demand at the firm's minimum average cost in the long-run) and output will be higher, at Q_2 (Figure 4.1). Under oligopoly, prices are indeterminate, but it is known they will either equal P_2 (under the Bertrand equilibrium) or lie between P_1 and P_2.

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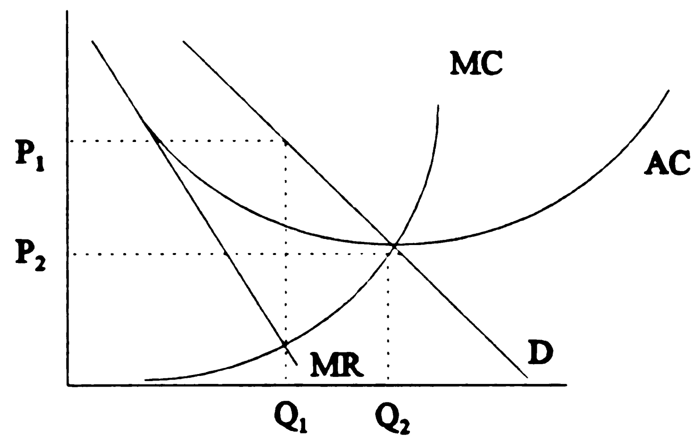
Figure 4.1 Pricing Behavior Options Under Different Market Structures



The fertilizer hedonic price model presented in the following chapter will determine the magnitude of the price differences in the alternative price setting arrangements employed by regional governments. Understanding how alternative arrangements affect the price level, other factors constant, can shed light on how to develop a lower-cost fertilizer subsector.

The price setting mechanism in Amhara was primarily through private negotiation between a government-nominated supplier (Ambassel) and the Amhara Regional Government (GMRP 1998). Unlike in the Oromiya Region, there were no fertilizer auctions held in Amhara. Ambassel was designated by the regional government as the primary supplier for NEP and regular credit sales. AISE, EAL, and Fertiline also distributed in Amhara, but were instructed to distribute only after Ambassel ran low of stocks (particularly urea). All credit prices by these distributors were settled between the integrated retailer and the regional government.

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Three distinctly different pricing mechanisms were present in the Oromiya Region in 1998: fertilizer auctions, private negotiations between the regional government and suppliers, and the competitive open market. Of the three regions, Oromiya had the greatest proportion of fertilizer auctions. However, in many weredas the announcement to hold an auction was retracted and Dinsho, owned by the regional government, was the government-nominated supplier. In other weredas Dinsho distributed fertilizer for the early maize crop, but fertilizer auctions were held for the later tef and wheat crops. Whereas the large wholesalers were invited to submit bids for the auctions, the independent retailers were not permitted to participate because they were told they were not permitted to sell on credit. It is speculated that the government did not trust that these retailers would be able to uphold their contract (GMRP 1998).

A characteristic of the pricing behavior in many government-designated markets was that at the time that the down payment was collected from farmers (especially for the earlier maize crop in Oromiya), the fertilizer price was not known. The DAs (extension agents) or SC officials estimated the down payment based upon last year's fertilizer price. They reported that the delay in announcing the price was because the price was still being negotiated between the government and Dinsho, the nominated supplier (GMRP 1998).

In the Southern Region, most fertilizer prices were set in a private negotiation between Wondo–the designated regional supplier–and the regional government. Toward late July, when Wondo's stocks were low, a nominal fertilizer auction was held in which AISE was the only bidder. However, AISE's bid offer was not accepted. The regional government told AISE that it had to lower its price to an average of the earlier, *belg* price and

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and the previous year's *meher* price if it was going to sell in the region. AISE conceded, it was too late in the season to redirect its stock to another market.

In sum, this section demonstrated that the regional governments were instrumental in determining the pricing arrangements and even predetermining the results of the pricing process. The government determined who could submit bids for the particular regional auctions, in effect the government partitioned the national fertilizer market into "regional markets." Now that the principle pricing mechanisms have been introduced by region, the pricing mechanism characteristic of specific actors--vertically integrated firms, independent retailers (who sell only in the open market and purchase supplies from the integrated firms), and service cooperative--will be studied.

4.1.3 Pricing Behavior by Vertically Integrated Retailers

The majority of fertilizer retailers in Ethiopia are vertically integrated backward into wholesaling and/or importing. AISE, Ambassel, EAL, Fertiline, and Guna retail fertilizer to farmers that they themselves import. Dinsho and Wondo, "government" retailers in the Oromiya and Southern Regions, respectively, purchase their stock from these importers/wholesalers. Without comprehensive cost data it is difficult to definitively define the pricing strategies of the fertilizer retailers. However, an understanding of the structure of the market combined with anecdotal evidence from the fertilizer subsector survey provided evidence to support speculations.

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One key characteristic of oligopoly pricing is conjectural variation: the recognition by members of an oligopoly that the outcomes of their strategies are critically dependent on how their rivals react to their actions (i.e., perceived mutual interdependence) (Staatz 1996). However, what was distinctly different about the fertilizer sector in Ethiopia in 1998 from most oligopolies was that one of the competing players was the government and its actions were not necessarily constrained by speculation to how other firms would react. This section examines whether fertilizer distributors in Ethiopia followed specific strategic options in determining prices in 1998 and whether such options were constrained by government moves in the market.

Monopoly Rents? Provided a firm faces the entire market demand curve and it is successful in mitigating the threat of entry, a firm may be able to gain monopoly rents in a market. This was the case in Amhara, SNNPR, and in some areas of Oromiya: prices were determined privately between the government-nominated supplier and the government. In Amhara, the FDRE told all distributors, aside from Ambassel, that they were not permitted to distribute to farmers in the region. One fertilizer importer/retailer reported, "Ambassel gave us a hot warning not to enter the market" (GMRP 1998). Due to the absence of competitors, the only potential constraint to achieving monopoly rents in Amhara by Ambassel was a check by the regional government:

> Of the 4 consecutive months in which the SCs were active in distributing fertilizer to farmers, the first 2 months were the time that no supplier except Ambassel participated in the wereda. It was also the time to sell in which the farmers seriously needed fertilizer for their maize plots. Ambassel therefore, has got an opportunity to sell with whatever the price it sets by itself (GMRP 1998).

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However, Ambassel's shortage of stocks eroded its ability to prevent new entrants into the credit and open market. AISE and EAL were able to enter the market once it became clear that Ambassel had insufficient stock, particularly urea. AISE entered the market with prices roughly 3-5 Birr/quintal less than Ambassel's prices (Table 4.2). Ambassel declared that AISE would have to set its sale prices the same as Ambassel, but to little avail--Ambassel dropped its credit price by 2-6 Birr/quintal.

Table 4.2 Sample Prices Between Ambassel and the AISE, Birr/Quintal, June-July 1998

	Ambassel, Before AISE's Entry		AISE, Upon Entry	
	Credit	Cash	Credit	Cash
DAP	245.0-249.5	249.5-253.0	243.0-245.0	243.0-245.0
Urea	206.0-206.5	na	198.0-203.0	198.0-203.0

Source: GMRP, Input Subsector Survey 1998.

Observations about the way Ambassel operated in the region contradicted how private firms operate in a developed market: how could a supposedly private firm dictate to other market participants what price to set? In a market economy the role of government is to encourage private sector investment by reducing transaction costs, minimizing risk, and reducing uncertainty--not play favoritism.

Once AISE and EAL entered the market in Amhara, Ambassel practiced coercion and entry deterrence to maintain its market share. The objective of exclusionary (coercive) strategies is to gain advantage over, weaken, control, or eliminate competitors (Staatz 1996). For example, Ambassel attacked rival product quality by announcing that farmers should not purchase supplies from AISE because AISE's fertilizer had expired.

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AISE denounced the claims, reporting that "distorted information was provided to the farmers by Ambassel about AISE to win the market" (GMRP 1998). Ambassel's tactics were reported to be "blaming and undermining" (GMRP 1998).

Coercive tactics in the Southern Region were also not uncommon in both the open and credit markets. EAL wanted to participate in the fertilizer auction for credit sales, but the government did not accept its offer on the grounds that EAL did not currently have any stock in the region, whereas AISE did. Perhaps the regional government was concerned that EAL would not be able to deliver promptly. EAL felt this was an unfounded excuse provided by the regional government to give the market to AISE (GMRP 1998).

The regional government in the South also played a heavy hand in discouraging open market sales. It was reported that the stores of the independent retail distributors were locked by the regional authorities to prevent them from distributing (GMRP 1998). In the southern zone of Kembata one independent retailer in the open market complained bitterly that market entry was more difficult now than in previous years because the government was prohibiting retailers from operating in order to encourage NEP expansion. This retailer explained that his store was closed by Wondo who had "political backing" because he offered a lower cash price than the credit price. He was informed that he could operate as long as his price equaled that of Wondo, the government-favored distributor. Independent retailers in other Southern zones stated that farmers were intimidated by local government officials so they only bought on credit from Wondo's retail outlets.

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Cross Subsidization. Another strategy to undercut competitor's prices is cross subsidization. Cross subsidization occurs when a firm subsidizes one product with receipts from another to gain a competitive advantage or to establish a market niche (Staatz 1996). This may occur across geographic regions or across different business activities within one firm.

Overall, it is difficult to decipher if this is occurring in the Ethiopian fertilizer subsector because many of the costs (e.g., storage and transport) are joint costs across more than one activity. Fertilizer trade is not the sole business activity of most large scale and independent retailers; therefore, they have the ability to practice cross subsidization. For example, EAL and Fertiline are companies in which the fertilizer business is only one business among many. EAL has been involved in a variety of businesses since the late 1970s--including sales of other agricultural inputs and machinery. Fertiline is an off-shoot of The Nobel and Trustworthy House Private Ltd. Enterprise which imported a wide range of consumables (e.g., Gillette products and pharmaceuticals). Both companies had the financial means to subsidize one product with receipts from another product to gain a competitive advantage or establish a market niche. AISE did not have this advantage. Government officials sit on the board of directors at AISE and it is prohibited by law from selling below cost (GMRP 1998). Overall, the ability of the large wholesalers to practice this option in pricing fertilizer can create a potential barrier to entry to competition.

Dumping. Dumping may occur when a firm recognizes its carry-over stock is a sunk cost and therefore its primary objective is to liquidate its stock which can mean selling below cost. The 1998 fertilizer market has been referred to as a 'slaughter' due to overs

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oversupply and the consequential decision by many firms to dramatically cut prices and sell below cost. To some extent EAL was successful in liquidating its carry-over stocks it had in the Amhara Region since 1995. EAL reports having lost at least 10-15 Birr/quintal in Amhara in 1998 (GMRP 1998). Thus the price of EAL open market sales was very low relative to AISE, a government body, who, as mentioned above, was by law not permitted to sell below cost. Coordination of demand and supply was a common problem in the fertilizer subsector and thus the perpetual risk of large carry-over stocks being liquidated can create a disincentive for other potential entrants at the retail level.

Collusion. Ultimately firms prefer cooperation to competition. If two firms do not collude, a Bertrand equilibrium[36] will result whereby each firm sets the competitive price as the consequence of the fear that the rival will undercut a firm's price and steal the entire market.[37] However, if firms successfully collude then each can capture rents by raising their prices above the competitive price. Prior to 1998 the large importers/wholesalers were able to split the market fairly successfully so there was little competition at the retail level. It is theorized that the integrated retailers that participated in the auctions colluded in setting their offer bid prices such that they could divide the market among themselves. The price model presented in the next chapter tests the hypothesis that the bid prices where auctions were held were lower than prices in markets where the regional governments awarded the market to a particular firm. In addition, due

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[36]Also called a Nash equilibrium.

[37]The equilibrium condition can potentially hold when two firms have the same cost structure and their products are undifferentiated.

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to collusion the bid prices in auction markets may not have been as low as prices in the more competitive cash market offered by independent retailers.

4.1.4 Pricing Behavior by Independent Retailers

Independent retailers are defined as traders who purchase their supplies from the larger, integrated retailers and are not permitted to participate in the government credit/input programs. In 1998, independent retailers traded between roughly 200-3,000 quintals in the *meher* season (GMRP 1998). Often the independent retailers that traded more than 3,000 quintals were not truly independent but were sales agents for the integrated retailers. Independent retailers were engaged in fertilizer trade primarily during the four or five months of a year in which farmer demand is at its peak. The primary business for these traders may be merchandise trade, transport, hotel, or grain or oil milling.

Independent retailers primarily set prices through a private treaty with a buyer but they may be price takers depending upon the proximity and volume of her/his competitors. To the extent to which the integrated retailers were also in the market (from whom the smaller retailers purchased there stock), profits margins of the small retailers were eroded between 1997 and 1998 (GMRP 1998). The integrated retailers often set their cash (retail) price equal their wholesale credit price. Survey evidence suggests that profits of the independent retailers were higher in weredas where the credit program was deficient in meeting the needs of farmers and where the larger wholesalers were absent from the cash market (GMRP 1998).

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4.1.5 Pricing Behavior by Service Cooperatives (SCs)

Prior to 1998, much of the fertilizer supplied in Ethiopia was channeled through SCs via the credit programs. Not only did the SCs provide the necessary structured framework for organizing fertilizer distribution but they may have had their own agenda and in many cases charged for services provided farmers by adding a margin to the credit price set by wholesalers.

In 1998 there was a large degree of variation in the extent to which SCs were engaged in fertilizer distribution activities. Under the Derg, SCs actively traded in agricultural inputs and consumables; however, during the war in which the military regime was overthrown, many of the fertilizer sales outlets, the SCs, were destroyed. The number of SCs fell from 2,900 in 1989/90 to 550 in 1991/92 (IFDC 1993 from Demeke 1995). Rebuilding the SCs has been slow. For SCs to operate, the FDRE requires strict guidelines for formal registration. By 1998 only a fraction of the previously existing SCs had restructured. The primary activities among those that were active in 1998 were buying and selling grain, grain milling, provision of animal drugs, sale of farm tools, and sale of a variety of consumables (e.g., sugar, salt, soap, blankets, nails).

In 1998 in the Oromiya and Amhara Regions, many SCs had rebuilt themselves and were once again active participants in the fertilizer sector. For credit sales under the regular program, SC personnel often assisted in gathering the demand estimates and down payment from their members. However, contrary to 1997, in 1998 the Southern Region SCs were no longer engaged in fertilizer distribution due, in part, to inadequate repayment rates of fertilizer loans by the SCs, but also due to the rapid expansion of the NEP and the subst

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substitution of NEP credit for SC regular credit. Prior to 1998 the SCs in the Southern Region negotiated a margin with the suppliers. The Ministry of Agriculture used the SC facilities but not SC personnel to distribute NEP supplies.

The extent to which SCs were active in open market sales depended upon the demand for open market sales in the wereda (the demand rose in weredas in which credit was restricted) and the degree of organization of the SCs. SCs often reported that they preferred credit sales because they were able to obtain a higher margin than with cash. With cash sales, SCs were competing against the large distributors from which they purchased their supplies (similar to the independent retailers). However, a key differentiating feature was that SCs would distribute fertilizer from the SC, often closer to the farmers than the sales outlets of the integrated retailers located in market towns.

On average the margins charged by SCs for credit and cash sales in Amhara were 5.2 Birr/quintal and 4.4 Birr/quintal in Oromiya (Table 4.3). In general, SCs in the South were not engaged in fertilizer distribution. Among those that were, the average margin was lower than in either of the other two regions, 1.2 Birr/quintal.

Table 4.3 Distribution of Open Market and Credit Service Cooperative Margins Across Regions, Birr/Quintal

Region	Minimum	Maximum	Average	n
Amhara	0[1]	12	5.2	28
Oromiya	0	10	4.4	70
South[2]	0	7	1.2	6

Source: GMRP, Input Subsector Survey 1998.

Note: [1]Some SCs did not charge a margin.

[2]There were no SC cash sales reported in the survey in the South.

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In 1998, as a consequence of the new policy of restricted access to fertilizer credit only through the NEP in many areas, the demand for open market sales rose. On occasion, a SC would act independently of the credit program to secure open market supplies for its farmers when there was a shortage. In Amhara, for example, Ambassel did not have sufficient supplies to fulfill one SC's order for open market supplies, and therefore the SC went to AISE to purchase more supplies. However, a SC usually ordered fertilizer for cash sales along with government credit sales, and received the supplies when the nominated supplier delivered the supplies on credit.

Efforts by the SCs to engage in open market sales were often thwarted by government-influenced policies. As an example, in Amhara, SCs were discouraged from purchasing fertilizer for open market sales because Ambassel told the SCs that they could only raise their fertilizer price by 1 Birr/quintal above the wholesale price (GMRP 1998). At that margin the SC decided to refrain from entering the open market.

4.2 Product Strategy

Aside from pricing policies firms can also influence their market share by providing farmers with other attributes (Lancaster 1971, 1998) of fertilizer that may be demanded by farmers such as timely delivery, white colored DAP, and accessible stock (both in distance from the farm and in terms of timely sales hours).

4.2.1 Product Strategy by Vertically Integrated Retailers

Distribution Network. The large "retailers" were primarily wholesalers that sold in retail outlets in major towns along the major roads leading out of Addis. They generally provided fertilizer to SCs for their credit and cash programs but would not necessarily deliver the fertilizer to the SCs. Either the Wereda Bureau of Agriculture transported fertilizer to the SCs in case of the NEP; the SC officials collected it; or farmers were required to travel to the wholesaler's marketing center to collect it. This presented a problem. In South Welo, Amhara, "farmers couldn't afford to rent a mule or camel to collect the fertilizer in the town" (GMRP 1998). An additional drawback, from the farmer's point of view, was that often the retail outlet of the large retailers was only open certain days due to a shortage of staff.

If a company was awarded a government contract then their market was defined and much of the risk associated with marketing was removed. The presence of the government credit programs can reduce the incentive for the large retailers to seek out new markets. Ministry of Agriculture officials reported that the large companies "didn't deliver to remote areas even if accessible by truck" (GMRP 1998).

Each of the large importers/wholesalers had its own network of retail dealers. In the early 1990s the number of licensed retail and wholesale agents of these companies increased. This move mistakenly was interpreted as a sign that the fertilizer market was opening to private competition (KUAWAB 1995, World Bank 1995). AISE covered the largest geographic area with distributors, wholesalers and retailers in almost all parts of the country. In 1996 Ambassel was AISE's primary distributor, but in addition, AISE had

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103 wholesalers, 901 retailers, and it served 860 service cooperatives (Demeke et al. 1998). However, in 1998 the number of AISE retail marketing centers was reduced, particularly in the Amhara Region where Ambassel took over most AISE marketing centers (again, an indication that Ambassel had greater authority (government-granted) than that afforded traders in a market economy). In Amhara, AISE "was not operating at full potential. It is better to say its status as a little better than shutting down" (GMRP 1998). In 1996, EAL also had a wide-ranging network: 230 direct retail sales centers, 1,285 "private" retailers (commission agents), and 550 service cooperatives. In the Oromiya Region, Dinsho had a similar network as EAL in the zones of East Shewa, West Shewa, North Shewa and Arsi.

Product Promotion. As mentioned earlier, the integrated retailers distributed most of their supplies through the NEP or regular credit programs. Thus, there was little return to product advertising other to inform the government that the company had stock available for delivery. It is rumored that the qualifying factor for winning a bid was not only price, but also whether the supplier had stocks in the vicinity at the time of the bid (GMRP 1998). This was reported to be the reason for the dismissal of EAL in the auction in the South. Otherwise, the criteria for a government contract was related to being the favored company or by submitting the low-priced bid in an auction. However, in addition to government credit sales, most integrated retailers were also engaged in open market sales where a return to advertising may have been realized. For example, Ambassel was reported to have promoted its product by emphasizing that it had new stock, contrary to the expired bags supplied by its rival, AISE.

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Efforts to provide timely delivery of fertilizer to farmers were often thwarted by the slow organization of government credit as well as retracted government policies (both issues discussed further in chapter 7). There were several examples where integrated retailers tried to position supplies early, in their retail marketing centers or in SC warehouses. However, not all companies had this option. For example, in the Amhara Region, Ambassel was the only company with permission by the regional government to stock fertilizer in the SC warehouses prior to organization of the government credit program. In another case, a large wholesaler tried to get an "edge" in a market but was not rewarded for this tactic. AISE positioned stocks in December in the South but was refused permission to distribute in both the government credit program and open market sales until August when government-appointed Wondo ran short of supplies.

Open market sales appeared to be a secondary activity of the integrated retailers with the exception of companies that already had stocks in an area when they lost bids or when they were forced out of the government credit market when another company was granted sole distribution rights by the FDRE. With regard to open market sales, many integrated retailers reported that they provided delivery to farmers (61 percent), price reductions (35 percent), and promotion of prearranged contracts with farmers (31 percent) (Table 4.4). It is hypothesized that the extent to which product promotion occurred among the integrated retailers was overstated, because the subsector survey did not necessarily find evidence that these activities were occurring (GMRP 1998). The reported promotion of delivery to farmers conflicted with reports from Wereda Bureaus of

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Agriculture officials and members of SCs that stated that the integrated retailers usually only distributed as far as the wereda capital and not to farmers.

Table 4.4 Percent of Integrated Retailers[1] Engaged in Product Promotion Activities in Amhara, Oromiya, and Southern Regions in 1998

	Never	Sometimes	Often	Total
Repacking fertilizer into smaller bags	88	6	6	100
Using roving agents	81	0	19	100
Demo fields	100	0	0	100
Price reductions	30	35	35	100
Credit flexibility	81	6	13	100
Offer technical advice on how to use the products	61	11	28	100
Deliver fertilizer to farmers	28	11	61	100
Offer prearranged farmer contract	44	25	31	100
Promote cash sales	53	41	6	100

Source: GMRP, Input Subsector Survey 1998.

Note: [1]Multiple responses (18 in total) were recorded for each of the 7 integrated retailers.

4.2.2 Product Strategy by Independent Retailers

The independent retailers primarily relied upon word of mouth to promote their product. Retailers were also involved in the grain trade and flour milling which reduced the search cost for their fertilizer market. Independent retailers did provide farmers with price reductions and credit flexibility (GMRP 1998). In Jimma, a particular concern of the independent retailers was to provide farmers with the preferred white-colored DAP. White DAP can be used more efficiently because it is visible on the fields when broadcasted. Another concern of the retailers was that they provided farmers with 25-50 kilogram bags, rather than with a quintal (100 kilograms) (GMRP 1998).

Most independent retailers in 1998 wanted to expand their businesses next season (GMRP 1998). Among those that did not, the reasons cited were insufficient profitability and that the government credit program left no market for open market sales (GMRP 1998). The primary constraint to expanding their business was credit, but if traders could expand their business they reported that they would use roving agents more readily to sell fertilizer at the farmgate and would purchase fertilizer directly from importers (GMRP 1998).

4.3 Conclusion

In sum, this chapter outlined the range of pricing strategies practiced by fertilizer distributors as well as the non-pricing strategies to secure and expand a firm's market share. The chapter revealed that market conduct was important in determining market shares of distributors as well as influential in determining retail prices. Overall, both the government credit and open markets were less than competitive in many areas of the regions studied in 1998. Coercive tactics conducted by the wholesalers (often with government backing) were successful in allowing distributors to carve out market niches and reduce competition.

The following chapter tests whether the market conduct practices observed in this chapter were indeed significant in explaining the spatial variation in retail prices. If market conduct was important in determining prices in 1998 then it presents itself as a target for policy directives to influence the performance of the fertilizer subsector. Evidence from this chapter suggests that the organization of the market geographically and across the government credit and open markets is very heterogeneous. Ambassel dominated distribution of fertilizer for the NEP and regular credit sales in Amhara as did Wendo in the Southern Region. The introduction of fertilizer auctions in the Oromiya Region led to a relatively more even playing field among the integrated retailers. However, the "delay" in announcing bids in the Oromiya Region often meant Dinsho received the government credit fertilizer market for the earlier maize crop. Open market sales were relatively more profitable for independent retailers if a retailer could position herself/himself closer to the farmers, or in areas where the NEP or regular credit programs were absent or failed to meet farmers' demand.

CHAPTER 5

FERTILIZER PRICE HEDONIC MODEL

The previous chapters showed that national and regional governments play an influential role in the fertilizer market by determining which fertilizer companies were allowed to operate in the market, and the pricing arrangements that were used to determine prices. These moves by the government severely restricted the possible pricing strategies practiced by competitive firms. The fertilizer price model presented in this chapter will test the effect of government policy on fertilizer price outcomes. For example, do different market structures (i.e., distribution channels) and market conduct practices (i.e., alternative pricing arrangements) affect retail prices and did these practices have significantly different effects from one another? The valuation of characteristics of the fertilizer market will help determine which characteristics of market structure and conduct are relatively more favorable to building a lower-cost fertilizer market.

5.1 Hedonic Price Technique

A hedonic price technique is used to estimate retail prices of fertilizer in Ethiopia. Commonly used in environmental economics, it is a method for estimating a price for goods for which there is no market. Each non-market characteristic of the fertilizer market is defined as a good and bundled together to define the broader good, fertilizer. The hedonic price technique is related to, but preceded, Lancaster's theory (1971, 1998) that utility is derived from the characteristics of goods, not necessarily the good itself. On the demand side, utility is derived from the physical properties of fertilizer, but also by a package of attributes that are tied to purchasing fertilizer. Consumers demand a host of characteristics that are tied to the physical product, fertilizer, such as the availability of fertilizer credit and the timeliness of fertilizer delivery. For example, the price of fertilizer in the NEP may be relatively high because farmers demand credit, improved seed, and extension services that accompany fertilizer. On the supply side, producers distribute fertilizer but, in addition, they supply attributes such as readily accessible, interest-free, cash sales, or fertilizer in outlying rural areas. The interplay of the supply and demand for fertilizer with differing characteristics leads to a relationship between equilibrium prices and the levels of characteristics that is referred to as the "hedonic price function."

The hedonic price model represents equilibrium prices in a market--a locus of equilibria between bids for and offers of characteristics of the good.[38] The model specifies that price is a function of the determinants of both the supply side and demand side of the characteristics markets (Freeman 1993). The objective of the model is to determine the marginal implicit price of a characteristic which can be found by differentiating the hedonic price function with respect to that characteristic.

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[38]The underlying assumptions of the model are that preferences are weakly separable and firms are heterogeneous and thus their cost functions differ.

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Waugh (1938) was one of the first agricultural economists to investigate the effects of quality on prices. He used multiple correlation analysis to investigate whether quality characteristics such as size, shape, maturity, and other factors affected prices of vegetables in a Boston market. This inquiry was extended by Griliches (1971) who used regression analysis to adjust price indexes for quality changes over time. Today hedonic price models are commonly used by economists in the field of environmental economics to measure the marginal value of non-market environmental qualities (e.g., air quality), but the application of the technique has spanned a variety of applications. For example, the hedonic price technique has been applied in labor economics to estimate spatial wage differentials and is still used in its original design, to estimate the significance of product heterogeneity such as quality, grades and standards (e.g., Jordan et al. 1995, estimation of the quality characteristics of tomatoes). Overall, in all applications, the hedonic price technique is used to determine the implicit prices of different quality characteristics of a good.

The Texas Agricultural Market Research Center (1996) extended the hedonic price technique to capture different pricing institutions in the U.S. cattle slaughter market by the top steer and heifer packing plants. In addition to capturing differences in quality of cattle, the model also estimated the effects of market structure and conduct. Market concentration and different procurement and pricing methods that influence prices in an oligopoly were used to explain the variation in observed prices. Different pricing mechanisms such as forward contracts and formula pricing were included as explanatory variables. In addition, the market share of each firm in a region was included to capture characteristics of market structure--that slaughter cattle procurement is a concentrated market.

The price model presented here for fertilizer in Ethiopia will also try to capture whether different characteristics of the market, namely the pricing arrangement and distribution channels, influence prices. The model attempted to determine the underlying transaction and institutional costs explaining price differences across the regions. If the spatial variation in retail prices can be partially explained, then the hypothesis that the 1998 subsector was characterized solely by spatial market inefficiencies can be rejected.

5.2 Model Specification

The objectives of the model are to first determine whether there are regional fertilizer price differences, and if so, estimate whether the regional price differences can be further explained by different market characteristics. Ultimately, the goal of the model is to estimate the marginal values of these market characteristics and thus determine the impact of different market characteristics on fertilizer prices. The specific hypotheses are delineated as follows:

- transport costs will positively influence fertilizer prices;
- the quantity demanded by the NEP and regular credit programs will be inversely related to prices;
- the marginal value of fertilizer distributed through the extension program will be relatively higher than prices in the open market due to the presence

of non-competitive pricing arrangements in the NEP relative to the open market; and

- the presence of a fertilizer auction will negatively affect retail prices relative to areas in which the supplier was nominated by government--a "mandated" market.

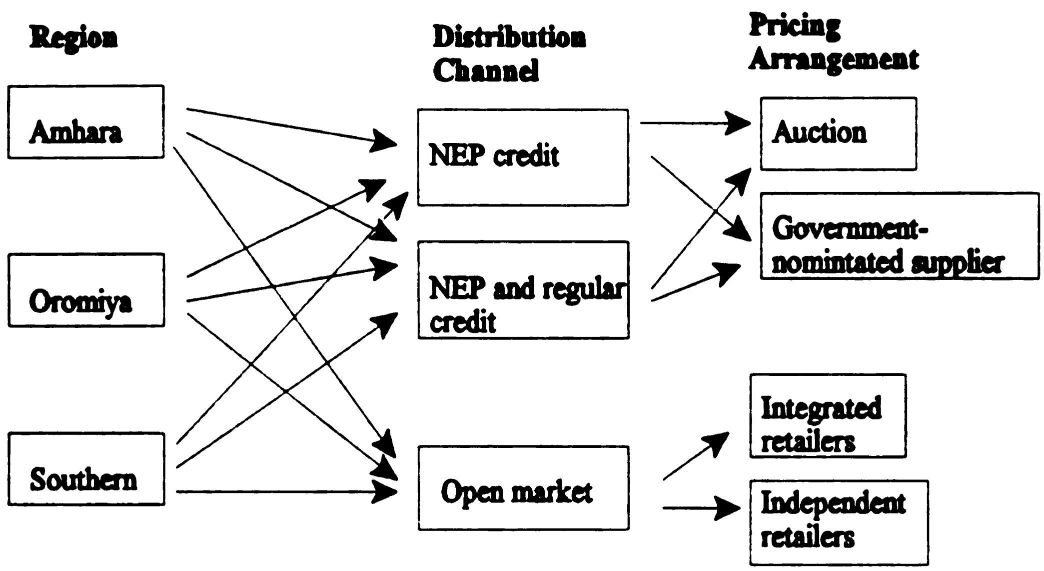
The hedonic price model is specified as follows:

$$(1)\ P = p(R, T, M, D, Q)$$

where P is the retail price of fertilizer; R is a vector of regional dummy variables; and T is a vector of characteristics of the good relating to transport costs. M, D, and Q are vectors of market structure: M is a vector of pricing mechanisms by which the good is provided, D is a vector of distribution channel characteristics, and Q is the volume demanded by the wereda for its credit programs.

Within each of the three regions of study, Amhara, Oromiya, and Southern, there were three distinct distribution channels and for each distribution channel there was a unique pricing arrangements by which prices were determined (Figure 5.1). The distribution channels were (1) the NEP credit program, (2) the regular credit program, and (3) the open market. The pricing arrangements were determined either through a fertilizer auction or privately between the government and the nominated-supplier for the credit programs, and competitive in the open market to the extent that there were competitors in the market but otherwise monopoly rents may have been realized. In the open market, sales were made either by the integrated retailers (who also participated in the credit programs) or independent retailers (who did not participate in the credit programs, they purchased their stock from the integrated retailers).

Figure 5.1 Pricing Mechanism and Distribution Framework



Four models were estimated for DAP and urea each (Table 5.1). The data for the price model was collected during the 1998 Input Subsector Survey by the Grain Market Research Project (GMRP). The dependent variable is the observed retail price of fertilizer measured in Birr/quintal. There are multiple observations of prices of DAP and urea in each wereda sampled, but the exact location of the quoted price within a wereda is not known. Retail prices used in the model are the prices farmers pay (excluding farmer interest). In cases where a farmer service cooperative (SC) adds a margin to the credit price paid by farmers, the margin is included in the retail price. There were no observed open market prices for the SCs although some SCs did engage in open market sales.

Fertilizer retail prices are recorded for the 1998 *belg* and *meher* seasons, a range of roughly 4 months from April through July. There are 376 prices for DAP and 291 prices for urea. The retail prices are quoted by the retail distributors as well as by Wereda Bureau of Agriculture officials and officials of the Service Cooperatives.

The models specified are linear in variables and linear in the parameters. Log-log and semi-linear models were estimated but the model results were not different from the linear model and therefore not reported.

Model 1 estimates prices against regional dummy variables to determine whether regional (spatial) differences exist in prices. It is hypothesized that prices in the Oromiya Region will be the lowest relative to prices in the Amhara and Southern Regions. The markets in Oromiya Region were generally closest to the port so prices will generally be lower than prices in the Southern Region and also lower than the south-western parts of the Amhara Region. The choice of regional dummy variables as opposed to a smaller political unit such as a zone is to test whether the FDRE's efforts to decentralize and shift responsibilities to the regions had been realized. The dummy variables would capture regional-specific input sector policies.

Table 5.1 DAP and Urea Model Specification

Model Specification	Definition
(1) P = p(R)	Model 1: price regressed on regional dummy variables
(2) P = p(R, T, M, D, Q)	Model 2: price regressed on regional dummy variables, transport costs, pricing mechanisms dummies, distribution channel dummies, quantity of fertilizer ordered for the credit programs
	Model 3: Model 2 plus a quadratic road density variable
(3) P = p(R, T, M, D, Q)	Model 4: Model 3 plus interaction effects between pricing mechanisms and distribution channels

Model 2 attempts to explain some of the significant regional variation hypothesized in Model 1. It estimates the additional explanatory power of distance from the port, road density, quantity of fertilizer ordered by the wereda, pricing arrangement dummies (i.e., government credit auction sales (in the intercept--see Table 5.4), government-appointed credit sales, independent retail open market sales, and integrated retailer open market sales), and the distribution channel dummy (the case where both the NEP and regular credit programs were available is in the intercept). It is hypothesized that prices will be positively related to the distance from the port and negatively related to road density.

Distance from the port of Djibouti to the midpoint of the wereda is used as a proxy for transport costs. The exact location of the observed prices within a wereda is unknown so the distance from the port to a rough estimate of the midpoint of the wereda is used as a proxy. Admittedly, there is some degree of measurement error in capturing this relationship. Most of the fertilizer shipped in 1998 arrived at the port of Djibouti; however, prior to the conflict with Eritrea, most imports came through Assab. A portion of the fertilizer consumed in 1998 was carry-over stock and originally arrived in Assab;

however, that stock is assumed to be a sunk cost and therefore, transport costs is no longer a factor in determining the supply price.

Using distance from the port as a proxy for transport costs assumes that transport costs are constant over time and constant over space. Both assumptions are false, but acceptable given the inability to identify the timing of delivery, nor the exact location of the observed price. Transport costs will increase as fertilizer travels off the main arteries extending from Addis and into outlying areas. Costs will also increase during the rainy season or during periods of peak demand for trucks (e.g., when food aid imports arrive). A quadratic form of distance from the port was included in the model to determine whether the relationship between the distance from the port and prices was increasingly or decreasingly positive. The quadratic, distance, failed to pass the hypothesis test that its coefficient was significantly different from zero and therefore was omitted from the model.

Road density was added to the model to explain some of the differences attributed to transport costs within a zone. Road density is calculated by weighing the lengths of 5 different road qualities (highest weight given to the highest quality road) observed in each zone and then dividing by the area of the zone. The highest quality road is an all-weather paved road and the lowest quality is a regularly traveled dirt path. In theory, higher levels of road density will reduce transport costs due to the cost savings from being able to haul fertilizer to its destination within the zone by truck rather than on bicycle or on foot.

In Model 3 (Model 2 will be explained shortly) the linear term of road density is extended by including a quadratic term. It is hypothesized that prices were lower in weredas with higher road densities and that the prices decreased at an increasing rate.

In model 2 it is hypothesized that there was a negative relationship between prices and the quantity of fertilizer ordered by Wereda Bureaus of Agriculture for their NEP and regular credit programs (a wereda-level variable). For each of the NEP and regular credit programs, regardless of pricing mechanism (bid or mandated market), the Wereda Bureau of Agriculture aggregated total demand for fertilizer, then found a contractor either through the auctions or privately. In a competitive market equilibrium, the quantity of fertilizer ordered by the wereda would be endogenous in a price-dependent model; however, it is not endogenous in this model because the quantity ordered for the credit programs occurred prior to and independently of the process of price determination. Quadratic and cubic powers were estimated for the quantity of fertilizer ordered by the wereda for its credit programs but they did not contribute to the explanatory power of the model and their coefficients were not significantly different from zero so they were dropped from the model.

As mentioned earlier, it is hypothesized that alternative pricing institutions will be a significant factor in explaining price variation. The observed pricing institutions were: auctions for credit sales, credit prices determined privately between the government-nominated supplier and the government, and open market prices. Dummy variables are used to capture these effects and are estimated at the price level.

It is hypothesized that an auction pricing arrangement will result in the lowest relative price due to the competition resulting from multiple bid offers for one tender. A Wereda Bureau of Agriculture issued tenders for a fixed quantity of fertilizer for each of the NEP and regular credit programs in its wereda. A separate tender was issued for DAP and urea and for each point of delivery at a SC. The Wereda Bureau of Agriculture invited integrated retailers to participate in the tender and the lowest-priced bid won.

Credit prices in government-appointed markets, where prices were determined privately between the supplier and the government, are hypothesized to be the highest due to the lack of competition. It is not known how the nominated supplier and the regional government decided upon prices. It is hypothesized the government-appointed contract prices are higher than the winning bid prices in the auctions. It is also hypothesized that the winning auction prices in the regular and NEP credit programs will be lower than the cash prices because independent retailers purchased their supplies from the integrated retailers that supplied the credit programs. However, cash prices are predicted to be lower than the credit price in mandated markets.

In many weredas the regular credit programs were replaced by the NEP credit program as the NEP gained momentum and SCs defaulted on regular credit. The model tested the effect of this administrative decision on prices. Did the effort to streamline the process of credit organization under the NEP put a downward pressure on prices relative to prices in which both SC and NEP credit programs remain? The model tested the degree to which the process of credit organization and fertilizer distribution were harmonized across credit programs. It is hypothesized that prices in weredas with both credit programs will be higher than prices in which only the NEP is available due to the additional administrative procedures required by any supplier who supplies both programs. There were only a few integrated retailers therefore it is probable that one wholesaler will supply fertilizer on credit for both programs where both programs are present. Additional costs may be required to supply (or offer bids for) both programs because even though both programs are administered by the Wereda Bureau of Agriculture, they had separate budgets and thus remained administratively separate. Thus transaction costs may be increased if the timing of the two programs is different and if separate paperwork is required to submit bids and process the contracts.

Model 4 includes interaction variables between the pricing mechanisms and the distribution channels. Within each wereda, prices were set separately in each distribution channel and by one of the identified pricing institutions. The interaction revealed whether the unique combination of choice of distribution channel and the choice of pricing mechanism affected prices significantly differently from their separate effects. For example, if prices were determined by an auction, does the fact that one wereda had only the NEP present and the other had both credit programs affect prices differently? Did integrated retailers offer higher bid prices when both programs were present relative to when there was only the NEP available to cover additional transaction costs?

5.3 DAP Model

This section will present the results of the hedonic price model for DAP. The mean DAP price was 239.5 Birr/quintal with a range from 212.5-270 Birr/quintal (Table 5.2). The mean distance from Djibouti to the wereda in which the price was observed was 983 kilometers with the distance ranging from areas north-east of Addis in the Amhara Region that are closest to the port to areas in the Southern Region and Western Amhara that are most distant. The greatest variation among the continuous variables is the quantity of DAP ordered for the credit programs in a wereda–ranging from 700-31,000 quintals.

Table 5.2 Descriptive Statistics of Continuous Variables in DAP model, n=386

	Mean	Std. Dev.	Min	Max
Price (Birr/qtl)	239.5	13.7	212.5	270.0
Distance from port (km)	982.6	164.6	523.0	1,294.0
Road density (100 km/km^2)	6.6	2.3	3.2	13.4
Quantity DAP ordered for credit programs (quintals)	8,931.7	7,479.9	700.0	31,028.0

Most of the observed fertilizer auctions were held in the Oromiya Region, with zero fertilizer auctions held in the Amhara Region and only 1 in the Southern Region (Table 5.3).[39] The distribution of the observed privately negotiated prices between the government and its nominated supplier was less skewed, with 50 percent of the privately negotiated prices observed in Amhara, 16 percent in Oromiya, and 33 percent in the Southern Region (Table 5.3). Prices offered by the independent retailers were predominately observed in the Oromiya Region (26/40 cases), followed by Amhara (11/40 cases) and the Southern Region (3/40 cases). The independent retailers were forcibly prohibited from selling in some areas in the South due to the active promotion of the NEP. As a portion of the sampled weredas, the Amhara Region had the greatest portion of weredas in which only the NEP was present, followed by the Southern Region, and

[39]The simple correlation coefficient between the Oromiya Region dummy variable and the fertilizer auction dummy is 0.54.

Oromiya where only 15 percent of the sampled wereda had only the NEP credit program present. Conversely, 85 percent of the weredas sampled in the Oromiya Region had both the NEP and regular credit programs available in 1998.

Table 5.3 Frequency Distribution of DAP Prices by Region, Number of Observations

	Amhara	Oromiya	Southern	Total
Pricing Mechanism				
Credit, auction price arrangement	0	120	1	121
Credit, private, govt.-nominated supplier price	64	20	42	126
Independent retailer open market price	11	26	3	40
Integrated retailer open market price	40	36	13	89
				Total = 376
Distribution Channel				
NEP only credit program in wereda	110	30	56	196
NEP and regular credit programs present	5	172	3	180
				Total =376
Total Observed Prices by Region	115	202	59	Total = 376

The estimated hedonic DAP model revealed that the identified characteristics of the DAP market, namely the pricing institutions and geographic market of fertilizer were significant in explaining the observed variation in prices (Table 5.4). Overall, regional dummy variables alone explained 45 percent of the spatial variation in prices and confirmed that indeed considerable variation in prices across the three regions exists (model 1). Prices in the Amhara Region were an estimated 21 Birr/quintal higher than prices in the Oromiya Region (in the intercept). Prices in the Southern Region were roughly 13 Birr/quintal higher than prices in the Oromiya Region. Thus, as expected,

Table 5.4 DAP Price Dependent Model Estimation Results, Birr/Quintal

	Model 1		Model 2		Model 3		Model 4	
	β	t[1]	β	t	β	t	β	t
Regional Dummies[2]								
Amhara	20.83	16.8*	14.15	8.66*	12.32	7.41*	10.81	6.12*
South	12.85	8.5*	5.63	2.92*	5.64	2.98*	2.89	1.42
Transport Cost								
Distance from port, (10s kilometers)			0.17	5.42*	0.19	6.34*	0.24	7.44*
Road density (100 km/km^2)			-1.21		-7.68	-4.79*	-7.15	-4.52*
Road density squared					0.37	4.08*	0.35	3.88*
Quantity for Credit Programs								
Quantity DAP (1,000 quintals)			-0.30	-4.46*	-0.38	-5.54*	-0.38	-5.58*
Pricing Arrangement Dummies[3]								
Cash, independent retailer			5.93	3.52*	5.92	3.59*	10.81	3.26*
Cash, integrated retailer			6.48	4.58*	5.77	4.13*	14.72	5.25*
Credit, government-appointed supplier			10.52	7.07*	9.90	6.76*	5.76	2.68*
Distribution Channel Dummies[4]								
NEP			1.70	1.23	1.37	0.93	-5.27	-2.35*
Interaction[5]								
Government-appointed supplier*NEP							12.99	4.03*
Cash, integrated retailer*NEP+reg							-11.95	-3.59*
Cash, independent retailer*NEP+reg							-4.16	-1.08
Constant	231.85	331.8*	222.26	54.32*	245.59	35.20*	239.99	34.05*
R^2	0.45		0.61		0.62		0.64	
Adjusted R^2	0.45		0.59		0.61		0.63	
n	376		376		376		376	

Notes: [1] T statistics, $H_0:\beta_i=0$: $H_1:\beta_i\neq0$, * indicates 5% significance, ** indicates 10% significance.
[2] The Oromiya Region is in the constant.
[3] The bid price from the fertilizer auction is in the constant.
[4] The distribution channel that is either the NEP or the regular credit program is in the constant.
[5] The bid price in weredas with the NEP and regular credit programs is in the constant.

prices are higher the farther the retail market is from the port (most fertilizer consumed in Amhara is in the western part of the region).

Model 2 adds in the effects of transport costs, pricing mechanisms and distribution channels which will shed light on whether the market is efficient. Overall, the magnitude of the effects of the regional dummies was reduced as expected--the model is now accounting for some of the physical and institutional factors that explain regional differences in model 1. The regional effect of Amhara dropped from 21 to 14 Birr/quintal above the intercept (the Oromiya effect, bid effect, and NEP plus regular credit program price effect). The distance from the port was significant at the 5 percent level as was the road density of a zone. The marginal effect of an additional 10 kilometers from the port was 0.17 Birr/quintal. The marginal effect of road density was -1.21 Birr/quintal. Thus fertilizer retail prices in zones that have higher road densities will be lower due to the lower transport costs of distribution within the zone.

Overall, distance from the port and road density were significant at the 5 percent level but the magnitude of their effect on prices was relatively small. The magnitude of the effect of pricing institutions was significant and relatively higher. The coefficients on three pricing arrangement variables were significantly different from the intercept--auction pricing arrangement in weredas with both the NEP and regular credit programs. Prices in "mandated" markets (i.e., one supplier identified by the government to supply all fertilizer) were the relatively highest, 10 Birr/quintal higher than bid prices. Thus a tentative conclusion can be drawn that relatively more competitive pricing institutions exerted a downward pressure on prices.

The open market prices by the independent retailers and cash market prices by integrated retailers were also higher than the auction process, by about 6 Birr/quintal in each case. Perhaps integrated retailers wanted to recoup losses in the cash market that they lost in offering below-cost bid prices in auction pricing arrangements. One distributor reported that he had to raise his cash price to cover the loss experienced by offering a lower-than-cost price in the auction (GMRP 1998). Alternatively, perhaps the cash market was not as competitive as first perceived. Perhaps high transport costs results in markets that were segmented and not well integrated.

A last finding from model 3 is that prices in the weredas in which only the NEP was present were not significantly higher than prices in which both programs were present. It was hypothesized that since the two programs were administered separately that distributors would raise their price to account for the duplication in paper work and added transport costs of separate delivery destinations for the two programs. Perhaps the distributors only supplied one or the other program. Also, perhaps the delivery point was the same for both programs, thus reducing the cost of supplying both programs.

Model 4 adds the interaction terms of pricing mechanism and distribution channel. The model runs into high collinearity problems and therefore some variables were dropped from the estimation (credit, auction*NEP; credit, government-appointed supplier*NEP+reg; cash, integrated retailer*NEP; cash, independent retailer*NEP). One observation from the model is that when open market sales by integrated retailers were interacted with weredas with both SC and NEP credit programs, the net effect of prices was that they were 2.77 Birr/quintal higher than the Oromiya winning bid prices in

weredas with both credit programs. This reinforces the earlier finding that cash prices of integrated retailers were higher than the corresponding integrated retailer's bid prices. Due to the additional transaction costs of providing a sales clerk to handle individual transactions, cash prices were higher than the pricing outcome of the auction process, other factors held constant.

The net effect of the independent retailer's price is 6.20 Birr/quintal higher than the Oromiya winning bid price with both credit programs present. As hypothesized, the independent retailer price is higher than the integrated retailer from which they purchase their stock.

5.4 Urea Model

A hedonic price model for urea is specified the same as the models for DAP, however, with 291 observations instead of 376 observations. The reduced number of observations for urea mirrors the distribution of fertilizer in the market: less urea than DAP is used in the three regions. There were no fertilizer tenders held in the Amhara Region, one tender held in the Southern Region, and 98 prices observed from auction arrangements in the Oromiya Region (Table 5.5). The observations for privately negotiated prices between the government and the government-nominated supplier were more equitably distributed between the three regions, with 64 observations in Amhara, 16 in Oromiya, and 35 in Southern. The region with the highest proportion of weredas with only the NEP present was the Southern Region (47 out of 142 observations). Similar to

DAP, Oromiya had the highest proportion of observations with both the NEP and regular credit programs available (131 out of 139 observations).

The mean urea retail price was 189 Birr/quintal, 21 percent lower than the average price of DAP observed (Table 5.6). The mean level of urea ordered for the NEP and regular credit programs was 3,237 quintals--less than half the quantity of DAP ordered. East Shewa, Oromiya, had the highest level of urea consumption across credit programs among the surveyed weredas. In fact, it was found that there was excess demand for urea in East Shewa; the excess supply of NEP urea in the South was resold in East Shewa (GMRP 1998).

Table 5.5 Frequency Distribution of Urea Prices

	Amhara	Oromiya	Southern	Total
Pricing Mechanism				
Credit, auction arrangement	0	98[1]	1	99
Credit, private, govt.-nominated	64	16	35	115
Independent retailer cash price	3	14	1	18
Wholesaler cash price	21	26	13	59
				Total = 291
Distribution Channel				
NEP only credit program in	82	23	47	152
NEP and regular credit programs	6	131	2	139
				Total = 291
Total Observed Prices by Region	88	154	49	291

Note: [1] The simple correlation coefficient between these two binary variables is 0.59.

Table 5.6 Urea Descriptive Statistics of Continuous Variables, n=291

	Mean	Std. Dev.	Min	Max
Price (Birr/qtl)	189.1	25.5	148.4	249.0
Distance from port (km)	954.1	169.5	523	1,294.0
Road density (km/km^2)	6.7	2.4	3.2	13.4
Quantity urea ordered for credit programs (quintals)	3,237.5	2,643.5	44	15,731.5

The urea model estimation results are presented in Table 5.7. Similar to the DAP model, the regional dummy variables revealed that there were significant regional differences in prices (Table 5.7). Prices in the Oromiya Region were 39 and 27 Birr/quintal lower than prices in the Amhara and Southern Regions, respectively. The regional dummies alone accounted for up to 46 percent of the variation observed in urea prices.

Similarly to the DAP model, model 4 estimation with the addition of interactive effects had high collinearity problems, therefore some effects were dropped from the estimation (credit, government-appointed supplier*NEP+reg; cash, integrated retailer*NEP; cash, independent retailer*NEP; cash, independent retailer*NEP+reg).

When other market characteristics were added to the model, the effects of the regions diminished as expected but were still strong. As with the DAP model, the winning bid price from auctions for urea was the lowest observed pricing mechanism relative to the credit price privately negotiated between the government and supplier and lower than the cash prices. The privately negotiated price was 21 Birr/quintal higher than the winning bid price (in Oromiya in weredas with both the NEP and regular credit available) and was

Table 5.7 Urea Price Dependent Model Estimation Results, Birr/Quintal

	Model 1		Model 2		Model 3		Model 4	
	β	t[1]	β	t	β	t	β	t
Regional Dummies[2]								
Amhara	38.77	14.72*	22.55	6.18*	18.22	4.67*	18.03	4.42*
South	26.87	8.76*	14.90	3.57*	14.59	3.54*	13.85	3.09*
Transport Cost								
Distance from port, (10s kilometers)			0.08	1.19	0.13	1.92**	0.16	2.29*
Road density (100 km/km²)			-1.54	-2.87*	-10.63	-3.31*	-11.49	-3.49*
Road density squared					0.51	2.87*	0.56	3.08*
Quantity for Credit Programs								
Quantity urea (1,000 quintals)			-0.66	-1.57	-0.50	-1.18	-0.46	-1.08
Pricing Mechanism Dummies[3]								
Cash, independent retailer			11.69	2.64*	13.61	3.08*	17.82	3.63*
Cash, integrated retailer			6.72	2.10*	5.17	1.62	24.50	2.49*
Credit, government-appointed supplier			21.12	6.50*	20.44	6.36*	15.60	3.46*
Distribution Channel Dummies[4]								
NEP			4.31	1.38	4.34	1.41	-14.63	-1.45
Interaction[5]								
Credit, Auction*NEP							14.71	1.28
Government-appointed supplier*NEP							24.47	2.33*
Cash, integrated retailer*NEP+reg							-21.44	-2.05*
Constant	174.68	119.90*	173.10	21.64*	204.21	15.23*	204.66	14.55*
R^2	0.46		0.59		0.60		0.61	
Adjusted R^2	0.45		0.58		0.59		0.59	
n	291		291		291		291	

Notes: [1] T statistics, $H_0:\beta_i=0$: $H_1:\beta_i\neq0$, * indicates 5% significance, ** indicates 10% significance.

[2] The Oromiya Region is in the constant.

[3] The bid price from the fertilizer auction is in the constant.

[4] The distribution channel that is either the NEP or the regular credit program is in the constant.

[5] The bid price in weredas with the NEP and regular credit programs is in the constant.

significant at 5 percent. One noticeable difference in the urea model from the DAP model was the effect of open market sales by the independent retailers. In the DAP model the cash prices offered by the independent retailers and the wholesalers were roughly equal relative to the winning bid price. However, in the urea model the prices offered by the independent retailers were 14 Birr/quintal higher than the winning bid price and the prices offered by the wholesalers are 5 Birr/quintal higher than the winning bid price from the auction process. This can be explained by the observation that in some of the Southern zones (i.e., Kembata) farmers would sign up for the NEP because it was the only available source of fertilizer credit but then sell their unused urea on the market for cash. Independent retailers would transport the urea north into Oromiya and sell it in areas where an excess demand existed.

As with the DAP model the quadratic on road density is positive and significant at 5 percent. The total effect of the government-appointed supplier in a wereda with only the NEP present is that it is 40 Birr/quintal higher than the intercept–the winning bid price in weredas with the NEP and/or SC credit. This sum is not unimportant–it represents 21 percent of the mean urea price.

5.5 Conclusion

The hedonic price model for DAP and urea revealed that significant price differentials observed in the three regions can be partially explained by transport costs (distance from the port and road densities in a zone), pricing mechanisms, and distribution channels. Overall, credit prices determined privately between the government and its nominated-supplier were significantly higher than prices determined in a fertilizer auction. This is a signal that one way to reduce retail prices is to introduce more competition into the retail market.

Another finding is that for both the DAP and urea models, the effect of restricting availability of fertilizer to the NEP program (using the auction process) did not result in prices significantly different from winning bid prices in weredas with both the NEP and regular credit programs available. This contradicted the hypothesis that the separate administration of the two programs meant higher transaction costs, and thus, higher prices. Another finding is that credit prices, when determined through a fertilizer auction, were significantly lower than cash prices. Overall, policy changes to encourage more competition at the retail and wholesale levels is recommended, perhaps first by reducing government favoritism in the market and thereby develop an open and transparent market.

CHAPTER 6

FARM-LEVEL DETERMINANTS OF MAIZE PRODUCTIVITY GROWTH

Understanding the farm-level determinants of maize productivity growth is an important factor in expanding adoption and long-term sustainability of high-input technology. The SG[40] program in Ethiopia proved that improved maize technologies exist which can double yields and dramatically raise net incomes and returns to labor (Howard et al. 1999). However, past SG programs in other SSA countries have shown that sustained use of improved farm technologies can be problematic if the overall system of technology diffusion and distribution is not well coordinated. Sustainable farm-level usage of new technology requires that problems of extension, credit, and input delivery be worked out in a cost effective and sustainable manner. Another concern is whether the SG program's success in expanding adoption in high-potential areas of Ethiopia can be replicated in less favorable agro-ecological areas and to farmers that may not be as well-suited (in terms of land, labor, oxen, and education) to adopt the new technologies and use them efficiently.

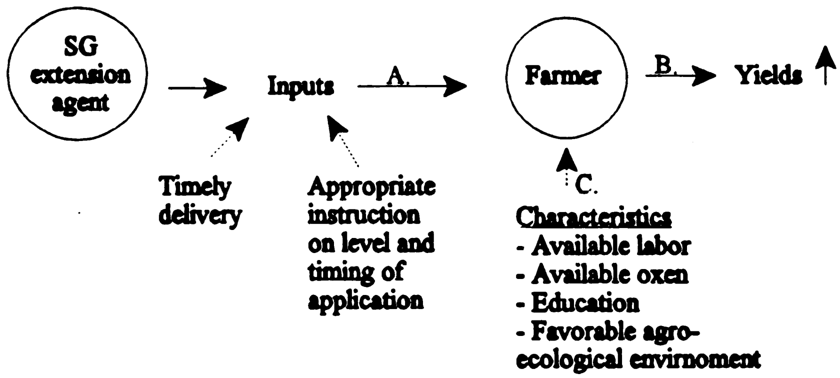
This chapter will investigate the productivity factors that contributed to the successful uptake of the SG technology by farmers. The following chapter on input

[40]Formally the joint program of the Ministry of Agriculture, Ethiopia and Sasakawa-Global 2000.

market performance will determine whether the NEP can maintain the SG quality of extension to introduce farmers to the new technologies, and equally important, whether input and credit markets are sufficiently developed to allow farmers to continue purchasing the inputs once they graduate from the NEP (farmers are expected to graduate after two years in the program). Evaluating whether Ethiopia can expand the SG success may depend on whether the NEP is able to duplicate the factors that contributed to the success of the SG on a larger scale.

There are three levels of analysis that are important for evaluating whether the stage is set for rapid agricultural productivity growth in Ethiopia. First, how did the organization of the SG enable it to efficiently (i.e., on time input delivery, adequate farmer supervision) provide its technological package--fertilizer, seed, and management practices--and are these factors present in the NEP (point A. in figure 6.1)? Second, what is the relative importance of each component of the technology package (e.g., improved seed, fertilizer, management practices) in increasing yields over the traditional practices (point B.). Additionally, to what extent was this success attributed to targeting well-equipped farmers in high-potential areas (point C.)?

Figure 6.1 Technology Transfer Flow Chart



6.1 Success of the SG

The SG was phenomenally successful in raising net income and returns to labor for maize production under high-input technologies (Howard et al. 1999). This success is, in part, due to a doubling and tripling in yields over traditional technologies of little to no fertilizer and local varieties of seed. The SG technology package consisted of specified level of inputs and timing of activities. For half-hectare farmer-managed plots, 12.5 kg (kilogram) BH-660 hybrid maize seed was recommended, 50 kg urea, 50 kg DAP, and 180 kg *marshal* (pesticide treatment for seed). The mean yield of the farmer-managed SG maize plots in 1997 was 5.4 MT/ha compared to 2.8 MT/ha on the traditional plots (Table 6.1) (Howard et al. 1999). However, in 1997 mean yields of 6.7 MT/ha on graduate plots (previous SG participants that were under the NEP in 1997) surpassed the SG yields, probably due to an efficiency gain from experience from improved management practices and modified levels of inputs in accordance with the deficiencies in the soil (Howard et al. 1999).

Although mean SG yields were high, there was considerable variance in yields across farmer plots within the same program. The observed variance in yields within programs raises the question: Do yields vary within the SG program due to differences in levels of inputs, differences in managerial practices, or soil or weather-related variables? In 1997 the mean yield in the lowest tercile under the SG plot, 4.1 MT/ha, was lower than the mean yield in the highest tercile using traditional methods (4.2 MT/ha) (local seed, DAP, no urea). The standard deviation of yields was 1.2 MT/kg for both SG plots and traditional plots, and 1.5 MT/kg for the SG graduates (Table 6.1). The higher variance among SG graduates is not surprising because some graduates continued to use the SG package under the NEP and others scaled back the SG-recommended level of fertilizer.

Table 6.1 Yields by Program Type for Maize in Jimma, Oromiya Region

Program Type	Yield (ton/hectare)[1]				Standard Deviation	DAP kg/ha	urea kg/ha	% use improved seed	n used in calculations
	1[2]	2	3	Mean					
SG	4.1	5.4	6.9	5.4	1.2	102.4	102.4	100	68
Graduate	4.9	6.8	8.2	6.7	1.5	96.1	96.1	100	38
Traditional	1.6	2.7	4.2	2.8	1.2	91.8	0	0	47

Source: Compiled from data provided by Howard et al. 1999.

Notes: [1]Yield differences between SG and traditional plots (plots belonging to the same SG households); between SG and graduate plots; and between traditional and graduate plots were significant at the 95% level.

[2] The first yield tercile includes the third of farmers that received the lowest yields, the 3rd tercile is for a third of farmers that received the highest yields.

Due to the large degree of variation in yields within each technology type, four technology types were specified to obtain an improved picture of the yield response from a given level of inputs (Howard et al. 1999). The specified technology types are: (1) local seed with no DAP; (2) local seed plus DAP; (3) improved seed and lower-than-SG recommended levels[41] of fertilizer; and (4) improved seed and recommended or higher levels of fertilizer (Howard et al. 1999). In general, technology types 1 and 2 refer to the traditional or "control" plot, technology type 3 is split between predominately graduates and the current SG participants (48 percent of SG participants and 61 percent of graduates). Type 4 is predominately SG current participants.

Table 6.2 Average Yields by Technology Type, With and Without the High-input Technology, kg/ha

Technology Type	Description	Yield, MT/ha	Standard Deviation, MT/ha	Net Income, Birr/ha	Net Income/ Labor Day	Nutrients, kg/ha	
						DAP	Urea
(1)	Local seed with no DAP	1.8	0.8	597	7.6	0	0
(2)	Local seed plus DAP	2.9	1.2	1,053	11.3	100	0
(3)	Improved seed and lower than recommended level of fertilizer	6.0	1.7	2,261	19.6	87	87
(4)	Improved seed and recommended or higher levels of fertilizer	5.9	1.4	2,107	13.0	116	116

Sources: Howard et al. 1999; Standard deviation calculated by author.

The standard deviation in yields across all technology types is not necessarily lower than the standard deviation across program types; however, it is now possible to conduct a comparative analysis of net income and returns across more narrowly defined technology packages (seed and fertilizer). Mean yields were 5.4 MT/ha for the SG program, but

[41] 100 kg/ha DAP and 100 kg/ha urea.

increased to 5.9-6.0 MT/ha for the high-input users (technology types 3 and 4) (Table 6.2). Another insight from the technology categorization is the contribution of DAP (not controlling for other factors): mean yields with DAP and local seed were 2.9 MT/ha, were higher than with local seed and no DAP, 1.8 MT/ha (Table 6.2).

Differences in yields translates into different levels of profitability of the technologies. Net income doubled from technology type 2 (local seed and DAP) to technology types 3 and 4 (improved seed, DAP and urea). Returns to labor also increased from 11.3 Birr/labor day (with DAP, no seed) to 19.6 Birr/labor day for (DAP, urea, and seed, technology package 3). Thus, a tentative conclusion (that will be tested later) is that the SG technology package increases yields. The finding that farmers in technology type 4 (who used at least the recommended level of fertilizer) received lower net incomes than farmers in technology type 3 (who used less than the recommended fertilizer dose) suggests that perhaps the fertilizer recommendation was too high.

6.2 Organizational Factors That Contributed to the SG Success

Once it is recognized that, in general, the high-input technologies (improved seed and fertilizer) contributed to raising net incomes and returns to labor, the factors contributing to this success must be understood for successful expansion of the high-input technology. These factors may be categorized into three influences. The first is the direct, technical relationship between inputs and output, and the second is the indirect influence of the organization of the SG program that permitted timely delivery of credit and inputs and encouraged efficient use of the improved inputs to farmers. The third point of influence is how well-suited a farmer is to maximize yields given the new technology.

There are several characteristics of the SG program that set it apart from the NEP (Table 6.3). Among the factors contributing to the success of the SG were: (1) the small-scale nature of the program, permitting close supervision (e.g., an average of 11 extension visits per farmer per season); (2) input delivery largely through the private sector, but facilitated by SG (e.g., there are instances where--at the expense of the SG--fertilizer was transported to ensure timeliness); (3) credit (without interest) administered and guaranteed directly by SG and its agents; and (4) a focus on better-off farmers in high potential areas.

Table 6.3 Key Differences Between the SG and NEP

Sasakawa-Global 2000	National Extension Program
pilot extension program	national production campaign
credit provided from own resources	credit provided by banks
program facilitated input delivery	primarily relied upon existing input delivery system
high extension agent-to-farmer ratio	lower extension agent-to-farmer ratio

The SG program began in 1993 with 153 plots, expanded to its maximum of 3,185 demonstration plots in 1995, and declined by 2,003 plots in 1997 when it withdrew from demonstration programs and shifted into post-harvest demonstration programs (Table 6.4). By contrast, the NEP began with 32,046 participants in 1995, increased dramatically in 1998 to 2.9 million demonstration plots (roughly 7 percent of the rural population), and planned to target 3.6 million in 1999 (Table 6.4).

Table 6.4 Number of Participants in the NEP and Sasakawa/Global 2000 Programs

	NEP	Sasakawa/Global 2000	Total
1993	0	153	153
1994	0	1,322	1,322
1995	32,046	3,185	35,231
1996	341,244	2,127	343,371
1997	600,634	2,003	602,637
1998	2,900,000	0	2,900,000
1999	3,600,000*	0	3,600,000

Source: MOA 1999.

Note: * Planned.

Although the NEP tried to replicate the design of the SG, its large-scale operation restricted its ability. The NEP is based upon the SG concept of closely supervised farmer-managed demonstration plots, with the same levels of recommended fertilizer and improved seed. In practice, many NEP participants were either "model" or "copy" farmers. The "model" farmers (who have been in the NEP at least a year) were used in lieu of extension agents to demonstrate to "copy" farmers how to use the new technology. The SG was designed as a pilot program whereby farmers would be exposed to the benefits of the high-input technology and would be encouraged to use the improved inputs after a couple years of close technical supervision. By contrast, the NEP is thought to promote the FDRE's goal of food self-sufficiency. Some even considered it a production campaign (GMRP 1998). This means that in effect NEP participants that should graduate from the program, do not. It is known that they will not be able to sustain the NEP practices without the facilitative role of the NEP (discussed further in the next chapter) in providing credit and inputs, thus the NEP will continue to enroll farmers past the recommended two years.

Many aspects of NEP administration differ substantially from the earlier SG program due to its reliance on a rapidly changing input markets. The rapid NEP expansion has taken place at a time of major changes in markets, policies, and institutions affecting the agricultural sector: a new credit system in 1994, gradual liberalization and privatization of the fertilizer market from 1991 to 1997 (when the last subsidies were removed), and government decentralization (administrative and fiscal responsibilities being shifted from the national to the regional level). The NEP credit system is more complex: (1) there are multiple actors (banks provide credit, regional governments guarantee credit, and development agents (DAs) approve participants and collect payments); (2) interest is charged; and (3) local police are used for enforcement.

In addition, the NEP needs to deal with a fertilizer sector characterized by supply inefficiencies often aggravated by policy uncertainties and government-protected markets. Whereas the SG had the resources to facilitate timely delivery of inputs, the NEP must rely upon the existing market mechanisms for delivery of inputs (government-guaranteed bank credit and input distribution system described in chapters 4 and 5) which often led to tardy deliveries (GMRP 1998). When asked about the differences between the SG and NEP, one NEP official replied, "The only difference is budgeting--the allocated budget by the SG was more than enough, unlike the extension program" (GMRP 1998).

Overall, the key administrative differences in the two programs may affect the NEP's ability to deliver a quality extension package and thus have an impact on productivity growth (discussed further in chapter 7).

6.3 Expanding High-Input Technology to the Broader Population

Fertilizer use is profitable for a portion of rural households that are currently using high-input technology at some level. Profitability of the new technology is a function, in part, of the yield received and thus also a function of whether the farmer is technically efficient (recognizing that the input/output price ratio is also a function). Highlighting the key differences in household profiles between fertilizer users and non-users can provide an insight of what factors may increase adoption and levels of fertilizer use.

Thus far it is shown that the organization of the SG may have allowed it to provide timely delivery of inputs, as well as a quality extension service, relative to the large-scale NEP. However, the successful use of the high-input technology on farms may only be partially attributed to such factors. Farmers' ability to use the package efficiently may complement a high quality extension service in order to realize the potential of the new technology. Can the SG technology be introduced to a broader set of farmers under similar agro-ecological conditions and face the similar impressive yield growth? Specifically, were the SG program participants better suited in terms of resources (such as animal traction, labor, education, timely inputs and credit) to use the new technologies more efficiently than the broader population? In addition, as the SG program is scaled-up, will the quality of the NEP–in providing low-cost, timely inputs and quality extension–be an important factor for expanded productivity gains?

6.3.1 Complementary Factors in Using High-input Technology Efficiently

The SG high-input technology is labor intensive relative to traditional technologies. The increased labor requirements of the SG high-input technology results in higher levels of labor used, but also an increased use of mutual (extended family) and hired labor. For both the SG and traditional plots, family labor is an important component of total labor, representing 61 percent of total labor days for the SG participants and 73 percent for traditional technology users. Mutual labor accounted for 25 percent of the SG's total labor days and hired labor accounted for 13 percent. For traditional technology users, mutual labor accounted for 15 percent of total labor hired labor accounted for 12 percent.

The numbers of family days under the SG plots in ploughing, planting, and particularly in weeding and harvesting activities was higher than the number of family days used on the traditional plot. It is the comparisons across mutual[42] and hired labor that is more striking. The number of mutual labor days in all activities for high-input users was 27.5 compared to 8.2 under the traditional technology (Table 6.5). Disaggregation of the sample into the lower and upper halves by yield reveals a rough positive relationship between the amount of mutual labor used in weeding and yields. The lowest yield half

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[42]Mutual labor refers to labor provided by close friends or extended family member with neither in kind nor monetary payment.

under the SG technology used 8.4 weeding days per hectare of mutual labor compared to 13.7 weeding days in the top half (Table 6.5).

Table 6.5 Average Level of Labor Use by SG and Traditional Technology

	SG Plot			Traditional Plot		
	Bottom half yields	Upper half yields	All Plots	Bottom half yields	Upper half yields	All Plots
Yield Range (kg/ha)	2,420-5,460	5,461-8,117		1,018-2,783	2,784-6,343	
sample size	n=28	n=29	n=57	n=23	n=23	n=46
yield (kg/ha)	4,441.5	6,444.1	5,460.4	1,918.8	3759.5	2839.1
DAP (kg/ha)	96.3	109.0	102.8	88.9	98.9	93.9
urea (kg/ha)	96.3	109.0	102.8	0.0	0.0	0.0
seed (kg/ha)	23.9	27.6	25.8	39.2	33.0	36.1
Labor (days)[1]	103.9	110.7	107.4	53.5	58.2	55.8
family	66.7	64.8	65.8	41.6	40.5	41.0
hired	11.4	16.7	14.1	4.0	9.3	6.6
mutual[2]	25.8	29.1	27.5	7.9	8.4	8.2
Total ploughing	31.8	32.1	31.9	18.4	18.4	18.4
family ploughing	28.1	28.2	28.2	18.2	16.8	17.5
mutual ploughing	3.6	3.2	3.4	0.2	1.5	0.8
hired ploughing	0.08	0.7	0.4	0.0	0.0	0.0
Total planting	15.1	13.9	14.5	8.4	7.8	8.1
family planting	5.7	6.8	6.3	5.9	5.2	5.5
mutual planting	9.4	7.0	8.2	2.5	2.6	2.6
hired planting	0.0	0.05	.03	0.0	0.0	0.0
Total weeding	38.3	44.5	41.5	16.4	18.9	17.6
family weeding	22.9	22.4	22.6	11.7	11.4	11.6
mutual weeding	8.4	13.7	11.1	2.9	3.9	3.5
hired weeding	6.9	8.5	7.7	1.7	3.5	2.6
Total harvest	18.7	20.2	19.5	10.4	13.1	11.7
family harvesting	10.0	7.4	8.7	5.8	7.0	6.4
mutual harvesting	4.4	5.2	4.8	2.2	0.3	1.3
hired harvesting	4.4	7.5	5.9	2.3	5.7	4.0

Source: Compiled from Howard et al. 1999.

Notes: [1]Labor day/ha, day=8 hrs. All columns are averages and thus line items may not sum to subtotals.
[2]Mutual labor refers to labor provided by close friends and relatives where neither an in-kind nor cash payment is made.

The SG package not only required additional labor, but required farmers follow specific guidelines on timing of planting and weeding and plant spacing. For example, the SG program recommended 3-5 plowings before planting and that the planting date occur during the rainy period, when the soil is moist. The SG recommended that the seeds are covered by hand; however, due to farmer reports of a labor shortages during planting time, oxen were often used to cover seeds (Buta 1997). The number of oxen days used on the SG plots is 23 days versus 21 on traditional plots (Table 6.6). Although few households own their own oxen, most farmers borrow (rather than rent) oxen through exchange of their labor services.

Table 6.6 Average Level of Animal Traction by Program Type and By Yield

	SG Plot			Traditional Plot		
	Bottom half yields	Upper half yields	All Plots	Bottom half yields	Upper half yields	All Plots
yield range (kg/ha)	2,420-5,460	5,461-8,117		1,018-2,783	2,784-6,343	
sample size	n=28	n=29	n=57	n=23	n=23	n=46
Animal Traction						
total ox days	67.9	66.7	67.3	41.7	47.2	44.4
own or borrowed	65.5	66.0	65.7	41.4	46.9	44.1
rented	2.4	0.7	1.6	0.3	0.3	0.3

Source: Compiled from Howard et al. 1999.

Note: All columns are averages and thus line items may not sum to subtotals.

A comparison of means revealed that the planting date and row spacing are two management variables in which deviations from the SG recommended practice negatively affected yields. Yields for farmers that followed the SG recommendation regarding planting date were significantly higher (5.55 MT/ha) relative to yields for farmers that did not follow the recommended planting date (5.03 MT/ha) (Table 6.7). Divergence from SG recommendations were not necessarily due to farmer negligence. If the delivery of improved seed or fertilizer is late, as was often the case for NEP participants in 1998, then planting, and consequently, the first weeding date will be delayed. Yields were not significantly different for the timing of the first weeding date or for plant spacing; however, they were significantly different for row spacing (Table 6.7).

Table 6.7 Mean Yield Comparisons Across Management Practices, SG and Traditional Plots, Jimma and West Shewa Zones, Oromiya Region

	Mean Yield (MT/ha)		
	Farmer practice equals SG recommendation	Farmer practice does not equal SG recommendation	2-tailed significance (p-value)
Planting date	5.55	5.03	.032
First weeding date	5.44	5.13	.286
Row spacing	5.86	5.15	.028[1]
Plant spacing	4.38	5.21	.229

Source: Compiled from Howard et al. 1999.

Note: [1]Null hypothesis of equal variances was rejected, test assumes unequal variances.

6.3.2 Determinants of Fertilizer Adoption and Intensity of Use

Given that efficient use of the high-input technology may require additional labor and management skills, the households that are relatively wealthier and better educated may be in a favorable position to achieve maximum yields from the new technology. Not only were there significant differences in key characteristics of farmers between the SG and the broader population in the Oromiya Region and nationally, but there were key differences between fertilizer users and non-users across the country. Regardless of agro-ecological area, there may be significant household factors across Ethiopia that determine whether a household will adopt fertilizer and use it efficiently. Identifying these factors can improve an evaluation of inputs market performance--whether the inputs markets are conducive to expansion of the high-input technology.

The probability of fertilizer adoption (whether or not a household uses fertilizer) and the intensity (level) of use is explained primarily by variables relating to access and profitability. Access can be endogenous to the household, *household access*, in terms of liquidity (e.g., crop income) and wealth (e.g., ownership of land and oxen), but there is also an issue of *market access* which is exogenous to the household. Examples of market access include household proximity to all-weather roads, access to information regarding prices and location of fertilizer supplies in the market. Both factors come into play for credit. The ability or inability to utilize credit may be due to a constraint internal to a household (lack of collateral or poor repayment record, for example), or exogenous because credit is not available for any households in the vicinity due to lack of banks in the area or government policy that restricts access.

Farm income, the net cash position and stock of wealth of a household, positively influences its ability to purchase fertilizer (Croppenstedt and Demeke 1996). In 1998, although most farmers received fertilizer on credit, a down payment (usually 25 percent of the principle) was required at the beginning of a season. In 1995/96 the gross income of households using fertilizer was 28 percent higher (3,241 Birr/season[43]) than for non-using

[43]Data is for the larger, *meher* season--a significant portion of most household's crop.

households (2,534 Birr/season) (Table 6.8). There was also a significant difference in the value of food crops between users and non-users with users receiving 2,260 Birr/season compared to 1,096 Birr/season (Table 6.8). Thus, crop income may be a constraint to fertilizer adoption, given that off-farm income was low--roughly 3 percent of total income (Table 6.8).

Table 6.8 Comparison of Mean Household Indicators Between Fertilizer Users and Non-Users

	Income[1] (Birr)	Value of food crops (Birr)	Value of food crop per hectare (Birr)	Value of off-farm income (Birr)	Value of livestock (Birr)	Hectares	Household size (Number of members)
Non-users[2]	2,534	1,096	1,373	80	2,140	0.88	4.9
Users	3,241	2,260	1,563	97	3,233	1.52	5.6
P>|t|[3]	0.050	0.000	0.00	0.079	0.000	0.00	0.000

Sources: Income variables provided by Yamano, T. and Central Statistical Authority 1995/96. Table computation by author.

Notes: [1] Income = value of food crops + value of cash crops + value of off-farm income + 0.2*(value of stock of livestock). The assumption is that 20 percent of the stock on livestock is income (e.g., sale of milk and eggs).

[2] 69 percent (1,947 households) of the sample are households that do not use any fertilizer. n=2,824.

[3] Two-sample t test with unequal variances.

In addition to a cash income, fertilizer users also have a larger stock of wealth, measured by land and livestock. The households using fertilizer had a higher value of livestock relative to non-users (Table 6.8). Livestock reduces the risk of using fertilizer and thus, its real cost because a household is "insured" against crop failure–they have the option of selling their livestock to purchase food. In addition, livestock--particularly oxen–are employed in ploughing activities (to prepare the seed bed) and are even used as a substitute for labor in planting (to cover seeds) and weeding activities.

Whereas farm size usually has a positive influence on fertilizer adoption, the effect on the level of fertilizer use may be positive or negative (Demeke et al. 1998). Much evidence supports the view that the incidence (as opposed to intensity) of adoption of high-yielding fertilizer varieties is positively related to farm size (Feder et al. 1985).[44] Although fertilizer appears to be a scale-neutral input, there may be a fixed "set up" cost in terms of locating markets and learning how to apply fertilizer. Farmers with larger land holdings may have greater access to extension, market information, and credit due to higher levels of collateral (the land) and/or higher levels of social capital in the area.[45] Overall, in Ethiopia land size is a strong predictor of fertilizer adoption (Demeke et al. 1998; Mekuria 1995; Kebede et al. 1990; Itana 1985).

Another reason larger land holdings may be an indicator for increased high-input adoption stems from the "safety-first" models (Smale et al. 1995). Farmers that are able to secure their food needs on a portion of their land may be more willing to take the risk of adopting a new technology on the remaining area. In Ethiopia, nearly 40 percent of rural households had less than 0.5 hectares of land and about 60 percent have less than one hectare (CSA 1995/96). Fertilizer users had, on average, 1.52 hectares of cropped

[44]An assumption here is that the effect of high-yielding varieties and fertilizer is the same.

[45]See Feder et al. 1985 for a discussion of Weil's 1970 land size/credit relationship.

area which was significantly higher than the 0.88 hectares for non-users (p=0.000) (Table 6.8).

Although a good predictor of fertilizer adoption, land size is not a good indicator of the level of use. The first five deciles of fertilizer users, using fertilizer least intensively, had an average of 1.62 hectares of cropped area compared to the last 5 deciles who had an average of 1.43 hectares of cropped area (Table 6.9). Households with relatively smaller farms may be inclined to intensify (use higher levels of fertilizer per hectare) because they do not have the option to practice fallow to maintain soil fertility.

Table 6.9 Average Level of Household Characteristic Per Fertilizer Decile

Fertilizer decile by fertilizer use per hectare		Household total cropped area, hectares	Value of household livestock, Birr	Number of household adult equivalents
Households that do not use fertilizer		0.83	2,489.22	4.07
Fertilizer deciles	kg/ha			
1	≤ 9.8	1.71	3,048.07	4.92
2	9.9 - 18.6	1.69	3,563.91	4.69
3	18.7 - 28.1	1.59	3,919.33	4.61
4	28.2 - 37.5	1.57	4,023.33	4.76
5	37.6 - 49.0	1.55	3,699.47	4.81
6	49.1 - 60.9	1.46	3,463.38	4.54
7	70.0 - 78.5	1.44	3,409.55	4.74
8	78.6 - 102.4	1.39	3,238.61	4.45
9	102.5 - 135.7	1.35	3,113.36	4.63
10	≥135.8	1.51	3,274.62	4.86

Source: CSA, Rural Household Survey 1995/96.

In general, factors such as access to credit and access to fertilizer are relatively more important than the profitability of fertilizer in determining whether a household uses fertilizer (adoption). However, the perceived profitability[46] of fertilizer is unquestionably significant in a farmer's decision of how much fertilizer to purchase (Crooppenstedt and Demeke 1996; Itana 1985; Demeke et al. 1998).[47] An indicator that profitability is important to the decision to use fertilizer is that most fertilizer is applied to tef, the most lucrative grain in Ethiopia. Tef is produced on 34 percent of cropped area for non-users compared to an average of 41 percent for fertilizer users (CSA 1995/96 and 1996/97). Additionally, among fertilizer users, there is a positive relationship between the amount of area to tef and the intensity of use. Fertilizer users in the lowest fertilizer decile allocated 31 percent of their area to tef compared to 45 percent in the highest decile (CSA 1995/96).

Profitability of alternative farm investments is also a consideration in the decision to use fertilizer. A household that is a net grain buyer may purchase fertilizer because it is cheaper to produce the additional grain than to purchase it on the market. In rural areas 75 percent of household expenditures are on food (World Bank 1998). Of the food consumed by households, 53 percent is obtained by cash purchases from the local market and roughly 45 percent of food consumed comes from subsistence production (World Bank 1998).

A separate issue to whether a household has the liquidity to afford fertilizer (household access) is whether the market provides the households the opportunity to use

[46]Represented by the incremental output due to fertilizer, and input and output prices.

[47]Because fertilizer prices were pan-territorial (do not vary across space) for much of Ethiopia's recent history, they can not be entered into econometric models.

fertilizer in an efficient manner (i.e., availability of information and access to inputs). High transport costs and lack of transport remain primary reasons for low productivity, lack of trade, and low incomes. "Supply-side constraints are often more important than demand factors in limiting growth in consumption" (Heisey and Mwangi 1997:195). The market price facing the farmer may not necessarily be a good indicator of profitability because it does not factor in the full cost to a farmer of using fertilizer which may include transaction costs such as transport or search costs. These "non-price" factors increase the shadow cost (financial plus opportunity cost) of fertilizer.

Increased intensity of infrastructure increases the probability that a household will adopt fertilizer (Demeke et al. 1998; Croopenstedt and Demeke 1996). The number of fertilizer distribution centers, number of commercial banks, and distance from markets in the wereda, and access to an all-weather roads were significant factors in predicting adoption. The World Bank calculated a normalized road index of 55 for Ethiopia, which is much lower than the index of 115 for Kenya and 144 for Zimbabwe (World Bank 1998).[48]

Another factor related to transaction costs is credit. Access to fertilizer credit can facilitate the use of fertilizer (by eliminating the search costs for fertilizer as well as easing the liquidity constraint). Prior to 1998, when SCs were the primary provider of input

[48]The normalized road index is calculated from the total length of roads where the expectation is conditioned on population, population density, per capita income, urbanization, and regional-specific dummies. The "normal" value id 100. If the index is greater than 100 then the stock of roads in a country exceeds the calculated expectation.

credit, farmer access to credit and therefore, inputs was improved with membership to service cooperatives (Demeke et al. 1998).

An important factor determining the level of fertilizer use (intensity) is knowledge of the recommended level of fertilizer use and farm practices that improve the profitability of use. In neoclassical economic theory profit maximizing households will increase the level of fertilizer until the incremental net revenue equals the cost of fertilizer. In practice, there are often liquidity, but also knowledge constraints to realizing this optimum. Variables that represent interaction with extension agents and farmer distance to extension offices (proxies for farmer knowledge) are important in determining variations in fertilizer use (Yirga et al. 1996).

6.3.3 Key Differences Between the SG Technology Package Users and the Broader Population

Similar to the comparison of fertilizer users and non-users, a household profile (i.e., selected characteristics) of SG program participants looks very different from the same household profile of typical agricultural households located in the same vicinity and covered by the National Central Statistical Authority Agricultural Sample Surveys[49] (Table 6.10). The SG participants were selected based upon the following criteria: farmers own their own farm land, were members of a farmer association, were clear of debt, had suitable land for the extension package, and were likely to repay their debt (Buta 1997).

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[49]The SG survey was conducted in 1997 and the CSA households were surveyed in 1995/96; however, a comparison is still valid on the premise that household characteristics such as farm size will not change significantly over 2 years.

The comparisons revealed that participants in the SG program cultivated more land (both absolutely and per capita), had larger household sizes (i.e., more available labor), appeared to have more capital (more livestock and traction animals), and had better educated household heads than the typical households described by the CSA data (Howard et al. 1998). For example, the mean hectares cultivated per capita in East Shewa was 0.62 hectares, 0.34 hectares in West Shewa, and 0.31 hectares in Jimma, compared to a mean of 0.21 hectares for all of Ethiopia (Table 6.10).

Table 6.10 Selected Characteristics of SG Participants Households Versus the Broader Population of Agricultural Households

	East Shewa (tef)[1]		West Shewa (maize)[2]		Jimma (maize)[3]		Ethiopia average
	Program partici-pants	CSA sample farmers	Program partici-pants	CSA sample farmers	Program partici-pants	CSA sample farmers	
Mean area cultivated (ha/household)	3.0	2.0	2.6	1.5	2.1	1.0	1.0
Mean population (persons/household)	7.1	5.7	8.7	5.5	7.4	5.0	5.2
Mean hectares cultivated per capita[4]	0.6	0.4	0.3	0.3	0.3	0.2	0.2
Percent of literate household heads	95	22	85	36	95	19	22
Mean Livestock Units per household[5]	5.1	4.7	5.4	4.0	4.7	3.1	3.5
Mean number of draft animals per household	2.7	1.9	2.3	1.7	2.3	1.5	1.1

Sources: Howard, J. et al. 1999; Central Statistical Authority, Rural Household Survey, meher crops, 1995/96.

Notes: [1]205 households from the Central Statistical Authority survey were used in the East Shewa analysis which covered Boset, Lome, Ada, Dugda, Arsi Negele, Shashemene, Seraro, and Akaki weredas.

[2]221 households from the Central Statistical Authority survey were used for the West Shewa analysis which covered Woliso, Becho, Ambo Zuria, Dano, Wonchi, and Dendi weredas.

[3]478 households from the Central Statistical Authority survey were used in the Jimma analysis which covered Limu Seka, Limu Kosa, Sokoru, Tiro Afeta, Kersa Mana, Goma, Gera, Seka Cherkorsa, Dedo, and Omanada weredas.

[4]Calculated at the household level first, then averaged across households to give each household equal weight in the calculation; note that the same result will not be obtained when dividing sample mean area by sample mean population.

[5]Calculated using following weights: cattle=1, sheep/goats =0.5, horses/mules =0.7.

The observed differences in level of household assets between SG participants and the broader population and between fertilizer users and non-users is a particular concern because efficient use of the improved technologies may be predicated upon a household's ability to draw on other resources (e.g., labor, oxen, and farmer skill in understanding, implementing, and fine-tuning management practices). The yield model presented in the following section will attempt to empirically test whether these complementary inputs are significant explanatory factors in the variation in yields. Overall, successful expansion of high-input technology across farmers will require attention to providing low-cost inputs as well as greater access to credit, extension, and fertilizer markets--factors that reduce the real cost to the farmer of using fertilizer and thus improve its profitability.

6.4 Yield Model

Thus far it has been shown that the organizational differences in the SG and NEP are likely to have an effect on the efficiency of inputs delivery in the NEP. In addition, the differences in household characteristics between the SG and broader population are also likely to have an impact on the efficiency of use of the improved technologies. An empirical test of whether the technology package (seed, fertilizer, and management practices) provided by the SG was significant in explaining yield differences across farmer plots can validate concerns about the NEP's organizational structure and its ability to deliver inputs efficiently.

To determine the marginal contribution to yield growth of the different components of the SG technology package it will be required to respecify a model estimated by Howard et al. (1999) which estimated yields as a function of technology type groupings (defined in section 6.1). By entering input and management practices into the yield model separately it will be possible to determine the importance of individual inputs as well as the quality of extension in adopting the new technology.

A secondary objective is to determine whether management practices (level and timing of input application) are more important to yield optimization on the SG plots relative to the traditional plots. In addition, the model will determine whether household-constant omitted variables are significant in explaining the variation in yields across households, after controlling for other inputs such as technology, soil characteristics, and management practices. To what extent is successful maize production a function of farmer's ability (among other factors)?

As was shown in section 6.2 the broader population was not as well endowed in terms of available family labor, thus it is hypothesized that they may not be able to use the new technologies as efficiently as the SG households. For example, fertilizer dramatically increases the population of weeds which, if not controlled, can reduce the potential yield from the new technology. It was also shown earlier that the broader population is not as educated as the farmers that participated in the SG program, thus it is questioned whether efficient use of the high-input technologies is dependent upon the strict management practices regarding planting and weeding dates and row and plant spacing.

6.4.1 Theory

Yield equations are derived from production functions to estimate the determinants of yield variability across farmers or tracts of land; however, they often do not adequately control for omitted factors such as farmer management (ability) which can bias the estimated coefficients. The "disregard of quality differences in our measures of labor leads to an upward bias in the estimates of the elasticity of capital inputs and a downward bias in the estimate of the elasticity of labor inputs" (Griliches 1957:8).

A typical yield function is specified without controlling for omitted factors: $Y = F(X_i, C_j, E_k)$ where Y is yield, X_i are management practices, C_j are variables describing the crop condition, and E_k are environmental variables (Byerlee et al. 1991). The X_i variables represent the level of inputs as well as the timing and method of their use. The C_j variables describe the condition of the crop, e.g., infestation by pests, and the E_k variables measure weather as well as soil and site characteristics.

The omitted variables that are often not controlled, such as farmer's management skills, characteristics of the soil, and weather, will influence explanatory variables such as the level of inputs, their timing and method of use, as well as the incidence of disease. If the unobserved farmer effect is uncorrelated with the explanatory variables then the unobserved effect is just another unobserved factor affecting yields which is not systematically related to the observable explanatory variables whose effects are of interest. However, if the unobserved effect and the regressors are correlated then serious estimation problems can occur, the estimated coefficients can not be consistently estimated. If the correlation between the omitted variable and a regressor is positive, then the coefficient on the regressor will be overestimated.

Estimation techniques have been developed, using information on agronomic practices on two different plots of land under the same farmer, to mitigate the omitted variable problem under certain assumptions. Given that there is some unobserved α_i that is invariant across plots of land for a single farmer, it is possible to remove the unobserved effect and consistently and unbiasedly estimate yield. The general model with an unobserved effect is specified as:

(6.1) $(y|\mathbf{x}_{ip},\alpha_i) = \beta_0 + \mathbf{x}_{ip}\beta + \alpha_i$

where y is yield, $\mathbf{x}_{ip}$ is a vector of input levels, agronomic practices, soil characteristics, and weather; and α_i is the unobservable effect for each farmer i and constant across p plots of land. An assumption is that the unobserved effect represents, among other things, the farmer's innate management skills that do not change across plots of land the farmer is cultivating. If it is assumed that the unobserved effect is allowed to be arbitrarily correlated with the regressors, a fixed effects (FE)[50] model can be used to estimate yields for 40 households that cultivate both a plot under the SG package and a plot under traditional methods.

A FE model is estimated by specifying a pooled OLS regression with the inclusion of dummy variables representing each α_i. In fact, the fixed effects estimator is sometimes called a dummy variable estimator. With the inclusion of n dummy variables, one for each farmer (with the omission of the one in the intercept), each α_i is estimated along with β:

(6.2) $y_{ip} = \alpha_0 + \alpha_1 h_1 + \alpha_2 h_2 ... \alpha_n h_n + \beta \mathbf{x}_{ip} + u_{ip}$,

where p=1,2 for plot one and two; i=1,2...n; $h_1...h_n$ are household dummy variables and the estimated $\alpha_1...\alpha_n$ are the individual household effects. Specifying the model with n dummy variables can be computationally cumbersome given models with thousands of individual effects (α_i) and limited computer storage space. Partition regression methods can be used in specifying an equivalent, and simpler model (Greene 1993). Given the typical linear unobserved effects model

(6.3) $y_{ip} = x_{ip}\beta + \alpha_i + u_{ip}$ for p=1... P,

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[50]If the unobserved effect is uncorrelated with x_{ip} then random effects (RE) is the appropriate estimation method.

a fixed effects transformation can be obtained by taking the average of (6.3) over p=1...P to get

(6.4) $\bar{y}_i = \bar{x}_i\beta + \alpha_i + \bar{u}_i$

where $\bar{y}_i = \frac{1}{P}\sum_{p=1}^{P} y_{ip}$, $\bar{x}_i = \frac{1}{P}\sum_{p=1}^{P} x_{ip}$, and $\bar{u}_i = \frac{1}{P}\sum_{P=1}^{P} u_{ip}$.

Subtracting (6.4) from (6.3) for each p reveals (6.5) which is the commonly used specification of a FE model:

(6.5) $y_{ip} - \bar{y}_i = (x_{ip} - \bar{x}_i)\beta + u_{ip} - \bar{u}_i$.

The plot-demeaning process on the original equation removed the individual specific effect α_i.

It must be recognized that the FE model specified will control for the omitted household variables, but will not control for the potentially omitted plot-level characteristics. It is conceivable that the farmer chose his or her most productive plot of land for the SG package (due to the higher cost of investment) and left the less productive land for the traditional methods. If the model does not adequately capture the factors influencing this decision, then biased estimates may exist.

6.4.2 Data

The data used in the model come from a Ministry of Agriculture/Michigan State University survey conducted in October and November 1997 of 80 farmer plots in Kersa and Seka Cherkosa Weredas in Jimma Zone, Oromiya Region. The model estimates yields for 40 households that cultivated two 0.5 hectare plots simultaneously: a plot under the SG package of improved seed, DAP, urea, and close extension supervision, and a traditional plot of only DAP and no direct extension supervision. Thus, because there are two plots of land for each farmer, it is possible to use FE as a method to control for household-constant factors.

The survey collected data on farmer input use and practices during the farmer's most recent *meher* season. Plot-level and household-level data was collected through farmer interviews. Thus, the recall period was roughly 8 months--from the time of planting in April/March thru harvest in October-December. Additional plot-level data, area of plot and yields, were measured directly by the enumerators.

6.4.3 Model Specification

Four different model specifications will be estimated, each estimated with and without FE (Table 6.11). The model is estimated in levels. This choice does not necessarily assume a linear relationship between inputs and outputs. The use of quadratic terms will be incorporated to capture diminishing returns. Log-log and semi-log functional forms were tested to determine whether they improved the fit of the model but they did not. Household dummy variables are used to estimate the omitted effects.

Model 1. The first model will estimate the effect of the SG package in its entirety (fertilizer, seed, and recommended management practices) on variation in yields across the plots under both the SG and traditional practices. It is hypothesized that the use of the package significantly increased yields over the traditional practices.

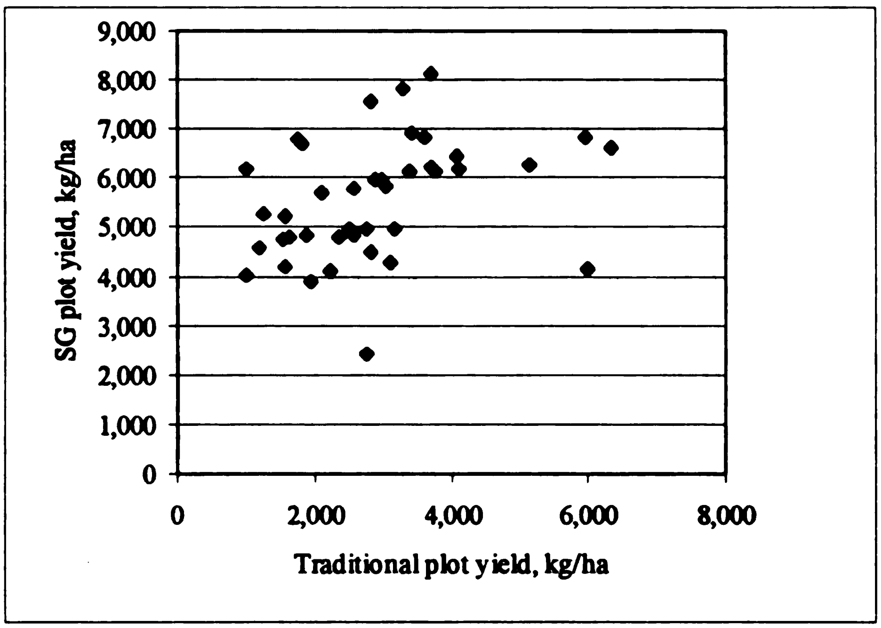
Table 6.11 Model Specification, n=80 (2 plots for each of the 40 households)

Model Specification	Model Defined
Model 1 $y_{ip} = \alpha_0 + \alpha_1 h_2. +...\alpha_n h_n + \beta_1 z_{ip} + u_{ip}$	Regress yield y_{ip} (kg/ha) on a dummy variable indicating whether the plot was under the SG technology, represented by the dummy variable for improved seed and urea, z_{ip}.
Model 2 $y_{ip} = \alpha_0 + \alpha_1 h_2 +...\alpha_n h_n + \beta_1 z_{ip} + \beta_2 x_{ip} + \beta_3 v_{ip} + \beta_4 w_{ip} + u_{ip}$	Same as Model 1 but with the addition of a vector of physical inputs, x_{ip} (DAP (kg/ha), seed (kg/ha)); a vector of soil and site characteristics, v_{ip}, (red soil dummy, dummy for presence of plant disease); and a management practice, w_{ip}, (difference in weeks between planting and weeding date).
Model 3 $y_{ip} = \alpha_0 + \alpha_1 h_2 +...\alpha_n h_n + \beta_1 z_{ip} + \beta_2 x_{ip} + \beta_3 v_{ip} + \beta_4 w_{ip} + u_{ip}$	Same as Model 2 but with the addition of quadratic terms for DAP, seeding rate, and weed timing.
Model 4 $y_{ip} = \alpha_0 + \alpha_1 h_2 +...\alpha_n h_n + \beta_1 z_{ip} + \beta_2 x_{ip} + \beta_3 v_{ip} + \beta_4 w_{ip} + u_{ip}$	Same as Model 3 but with the addition of interaction terms between inputs: seeding rate, DAP, improved seed dummy, and weed timing.

There a few key differences in inputs across the SG and traditional plots. First, only the SG plots used improved maize seed (a hybrid called BH-660); the traditional plots used indigenous varieties. The SG plots used equivalent levels of DAP and urea, 103 kg/ha each, higher than the 100 kg/ha recommended of each. The traditional plots used an average of 93 kg/ha of DAP but no urea (Table 6.12). Due to the high collinearity between urea and improved seed (r=0.96), seed type also represents the effect of urea. Seeding was conducted in rows on both the SG and traditional plots, however, the SG had specific recommendations with regard to row and plant spacing and seeding rate.

All models will first be specified without controlling for the household-constant effects and then respecified using household fixed effects. It is hypothesized that the household-constant factors may include farmer management skills as well as other omitted variables such as rainfall and soil characteristics (to the extent that these variables are not specified in the model). It is also hypothesized that the inclusion of household FE will influence the estimates of the regressors, to the extent that the regressors are correlated with the omitted factors. A graph of traditional yields against SG yields reveals that there may be an underlying structural relationship between the two farmer plots--a farmer's skill may positively influence yields on both the SG and traditional plots (Figure 6.2).[51] That is, if yields on a farmer's SG plot are above average, then it is likely that the farmer's yield on the traditional plot will also be above average.

Figure 6.2 Relationship Between Yields on SG and Traditional Plots



[51]The correlation coefficient between the SG and traditional plot yields was 0.35, at a 0.05 2-tailed significance level.

Model 2. The SG package will be disaggregated into its separate components–fertilizer, seed, and management practices. Model 2 will test the hypothesis that the separate elements of the SG technology package will have significantly different effects on yields, and thereby reduce the magnitude of the effect of the improved seed binary variable in model 1. Descriptive statistics revealed that although the SG technology package is standardized, the SG participants did not necessarily follow the recommendations with respect to level and timing of input application and management practices. Model 2 will attempt to reveal which inputs or management practices are especially critical for yield optimization.

Specifically, model 2 will build onto model 1 by adding a vector of physical inputs, $\mathbf{x}_{ip}$ (quantity of DAP and seeding rate), a vector of soil and site characteristics, $\mathbf{v}_{ip}$, (presence of red soil dummy and plant disease), and a management practice, $\mathbf{w}_{ip}$, (difference in weeks between planting and weeding date).

Agro-ecological Variables. Given that Ethiopian maize is predominately rainfed, the variations[52] and level of rainfall are key to a good harvest. Rainfall and other omitted soil and site characteristics, as well as household management skills, will be captured in the household dummy variables. However, to the extent possible, factors such as soil and site characteristics and plant disease will be controlled. Trial data revealed that red, gray and brown soils are particularly responsive to nitrogen and phosphate compared to black soil (ADD/NFIA 1992). A binary variable to represent red soil will be entered in the

[52]Moisture stress immediately following seeding has relatively little impact on yield compared to moisture stress later in plant growth, at and following flowering (Amede 1992).

model: 75 out of 80 plots had red soil and the remaining 5 had black soil. The slope of the plot (level or steep slope) was entered in the model, but it was not reported because its hypothesis test for significance failed. Plant disease, partly controlled by the application of herbicides,[53] is thought to negatively affect plant density, and hence yields. The incidence of plant disease, farmer's assessment of the magnitude of the problem, will be entered as a dummy variable.

Table 6.12 Descriptive Statistics of SG and Traditional Plots

		All Plots n=80		SG Plot n=40		Traditional Plot n=40	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Dependent Variable							
Yield (kg/ha)		4227.0	1846.1	5570.1	1208.8	2,884.9	1320.9
Continuous Regressors							
Seed (kg/ha)		30.2	10.1	26.3	6.3	34.1	11.6
Urea (kg/ha)[1]		51.5	53.8	103.0	20.6	0	0
DAP (kg/ha)		97.9	28.2	103.0	20.6	92.8	33.6
Number of weeks between planting and first weeding		5.2	2.6	5.2	2.3	5.3	2.8
		Number of Cases		Number of Cases		Number of Cases	
Binary Regressors							
Seed type	1=improved seed	40		40		0	
	0=local seed	40		0		40	
Soil type	1=red soil	75		37		38	
	0=black soil	5		3		2	
Plant disease	1=damaging	12		6		6	
	0=light	68		34		34	

[53]Only one farmer in the sample applied herbicides after planting. The improved seed was treated with a pesticide treatment, *marshal*, before planting.

Seed. Quantity and type of seed, their interaction, and plant density[54] are hypothesized to be important factors in explaining yield variations. Both SG and traditional farmers exceeded the recommended seeding rate (25 kg/ha), at 26.3 kg/ha and 34.1 kg/ha, respectively. It is hypothesized that this overdose negatively affected yields.

There is a trend of increasing yield with increasing plant density (provided sufficient moisture) (Amede 1992). Thus, there may be a misconception by farmers that more seeds means higher plant density. In general, recommended plant density is 44,444 plants/ha for full season varieties (as modeled here) (Amede 1992). However, plant density for both the SG and traditional plots was much lower: 27,375 plants/ha for the improved variety and 22,812 kg/ha for the local variety.

Farmers using the improved seed may have relatively more control over plant density for a variety of reasons, high-quality seed being one. Seeding density (kg/ha) for the improved seed was positively correlated with plant density (r=0.19), but there was a negligible relationship between seeding density and plant density (r=-0.03) with the local seed. Quality seeds contain sufficient nutrients to emerge, but animal and insect attacks and soil crusting immediately following planting can reduce plant density (Schulthess and Ward 1999). The SG recommendation regarding plant spacing (80 cm between rows, 50 cm between plants, and 2 seeds planted per whole) is one method to encourage farmers to increase their plant density. However, the recommendation did not produce the desired plant density--one reason for the less-than-recommended average plant density may be that 6 out of 40 farmers reported incidence of plant disease on their improved variety plot.

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[54]Measured as the number of plants per hectare, recorded roughly a month before harvest.

Nutrients. Ethiopian soils are predominately deficient in phosphate and nitrogen[55] and therefore, their application is hypothesized to significantly contribute to explaining yield variation. Tropical soils, in general, and specifically in Ethiopia, are either deficient in phosphate or have a high phosphate fixing capacity (thus rendering the phosphate unavailable for plant growth). Soils in Jimma Zone have historically been deficient in phosphate (Kena et al. 1992). Phosphate (P) is combined with nitrogen (N) in DAP (diammonium phosphate) which is 46 percent P and 18 percent N. DAP is primarily applied as basal, during planting. Phosphate is particularly valuable for stalk growth as well as increasing the effectiveness of nitrogen. The effect of P in Jimma can last for three years irrespective of the rate, but the effect decreases with time (Kena et al. 1992). Nitrogen, the one nutrient most needed by maize, is primarily applied as a top dressing, usually about a month after planting.

It is hypothesized that the level of optimum fertilizer use is a function of whether local maize varieties or hybrid maize are used as well as plant density. Plant density can be increased significantly if fertilizer is used in combination with hybrid seed. It is hypothesized that there exits a positive relationship between fertilizer and plant density–thus an interaction will also be added to the model.

It will also be tested whether the SG recommendations of 100 kg/ha DAP and 100 kg/ha are optimal to maximize yields, given the SG recommendations hold with regard to seeding rate and plant spacing and timing of weeding. It is observed (mentioned earlier in the chapter) that some SG graduates used lower-than-recommended levels of fertilizer and

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[55]Ethiopian soils are not deficient in potassium (ADD/NFIU 1992).

received higher yields than SG participants that followed the recommendations. As mentioned earlier, the SG plot received higher-than-recommended levels of fertilizer. The yield model will attempt to determine whether the recommended fertilizer level was too high.

Labor. As noted earlier in this chapter, the labor requirements of the SG technology were much higher than that demanded of the traditional technology. Labor may be entered in the yield model either in levels or in terms of timing of activities. Some activities such as planting (particular specifications on row and plant spacing were required) and weeding will require a substantial number of labor hours; however, in both tasks the quality of labor may also be important (perhaps more important than the quantity of labor).

Labor data (total labor days) as well as labor days by activity (ploughing, planting, weeding) were entered in the model, but the test hypotheses failed, they were neither jointly nor individually significant. Perhaps labor, thus specified, is unimportant in explaining yield variation because the quality of labor is not captured. Thus family versus extended family and hired labor were entered separately–the hypothesis being that the quality of family labor would exceed the quality of extended family members and hired labor. However, the hypothesis tests of significance of labor, when broken down by type of labor, also failed. One reason that labor was not significant may be that it is correlated with different inputs. For example, the simple correlation coefficient between use of improved seed, an indicator for the SG technology, and total weeding labor days is 0.69.

Management Practices. One method in which labor can be captured in the model is through the timing of application of different cropping activities. The SG program provided close supervision of the timing and method of input application on farmer-managed plots. The model will attempt to test whether specified extension messages (e.g., quantity of input application, plant and row spacing, and timing of input application) were significant in explaining yield variations. The quantity of seeds applied to the SG plot, in part, is an indicator of whether the farmer followed SG recommendations regarding plant and row spacing.

Timing of the first weeding is another important SG specification. Maize is susceptible to damage by the parasitic witchweed (*Striga* spp.) which caused a yield loss in Jimma as high as 36 percent when maize was left unweeded compared to when it was weeded three times (Fessehaie et al. 1992). In addition, it is reported the most Ethiopian smallholders practice a late first weeding (Ransom et al. 1992). In Jimma the SG recommended that the first weeding occur 4 weeks after planting.

In Jimma the majority of farmers weed by *shilshalo*–the practice of weeding using a pair of oxen--at 30 days, 40 days, and then again at 49 days after planting (Fessehaie et al. 1992). Oxen are commonly used in Jimma, particularly to prepare the seed bed, cover seeds, and for *shilshalo*. Oxen pull a *maresha*, a wooden plough that has a single metal chisel, to cultivate the soil. As shown earlier, SG participants owned more oxen than the broader population and yet oxen were still rented and borrowed. Most Ethiopian smallholders exchange oxen for labor services (Gordon et al. 1995). Thus, it is possible that weeding activities may be delayed due to the inability to obtain oxen, particularly if all farmers demand oxen services at the same time.

Another important variable in explaining yield variations is the timing of planting. Late planting can lead to greater weed problems, nitrogen deficiency, and water deficiency which can reduce yields (Ransom et al. 1992). The planting date was entered in the model as a dummy variable for whether the farmer planted during the recommended planting week, and two continuous variables, one for the number of weeks that the number of weeks exceeded the recommended planting date and another for the number of weeks that planting preceded the recommended week. All variables were dropped from the reported model because their slope coefficients were not significantly different from zero and they did not contribute to the fit of the model (measured by adjusted R^2).

Model 3. Model 3 keeps the variables as specified in model 2 but adds a quadratic term on DAP, seeding rate, and weeding timing. The number of weeks between planting and first weeding is expected to positively contribute to yields (allowing sufficient weeds to grow before weeding), however, after some date, late weeding (perhaps due to a labor or an oxen constraint) may reduce its impact on yields. Another variable that may face marginal diminishing returns is application of DAP. It is hypothesized that an increased application of DAP will have a positive net effect on yields, but the net effect will decline as the level of application increases.

Model 4. Model 4 attempts to improve the explanatory power of the regressors with the addition of interaction terms between the various inputs and timing of weeding. It is hypothesized that the net effect of any one input is sensitive to the levels of other inputs and practices and thus this will highlight the importance of farmer management in optimizing yields. In addition, it is hypothesized that the effect of inputs and practices may differ when combined with improved seed compared to local maize varieties. The combination of seeding rate and DAP is one interaction. Agronomic CERES[56] maize simulation modeling revealed that when improved maize seed is used, increasing plant density can significantly increase yields, but only when accompanied by fertilizer (Shulthess and Ward 1999). Increased plant density makes little difference in yields without fertilizer. It is hypothesized that seeding rate will have a negative slope coefficient, but when combined with DAP, it will be positive–seeding rate can be increased when combined with fertilizer because the added plant density is complemented by additional soil nutrients. It is hypothesized that the net effect of seeding rate is positive. It will be additionally tested whether the use of improved seed is important in determining the levels of seed and DAP.

6.4.4 FE Model Results

Model 1. The binary variable, improved seed/urea, is highly significant in explaining yield variations. On average, the SG yields were 2,685 kg/ha higher than traditional plot yields. Even when household-constant omitted factors were included in the model the magnitude of the difference remained roughly the same (that is, the

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[56]CERES (Crop-Environment Resource Synthesis) simulates crop growth for cereal crops, including maize, wheat, sorghum and rice. CERES and CROPGRO (for legume crops) models are specialized models within the larger, Decision Support System for Agrotechnology Transfer (DSSAT 3.0) model (Jones and Kiniry 1986).

Table 6.13 Plot-Level Maize Yield Model Results, kg/ha

	Model 1		Model 2		Model 3		Model 4	
	w/o FE[1]	w/FE	w/o FE[1]	w/FE	w/o FE[1]	w/FE	w/o FE[1]	w/FE
Seed and Fertilizer								
Improved seed/urea 1=improved seed/urea, 0=local variety/no urea	2685.11 (9.48)***	2685.11 (11.79)***	2451.80 (7.99)***	2674.73 (9.39)***	2361.21 (7.63)***	2569.60 (8.85)***	-618.55 (-0.43)	-113.02 (-0.07)
DAP (kg/ha)			11.80 (2.34)**	1.96 (.03)	21.71 (0.94)	-0.78 (-0.03)	-21.04 (-0.65)	-62.57 (-1.61)
Seed rate (kg/ha)			-18.76 (-1.18)	-3.61 (-0.20)	-132.77 (-1.35)	-181.59 (-1.48)	-304.15 (-2.84)***	-443.46 (-3.19)***
Management								
Weed timing - number of weeks between planting and first weeding			71.83 (1.33)	14.52 (0.14)	378.08 (1.91)*	160.04 (0.55)	682.80 (3.15)*	559.67 (1.91)*
Soil and Site Characteristics								
Red soil 1=red, 0=black			1124.69 (2.00)**	1470.19 (1.64)	1343.94 (2.35)**	1566.05 (1.75)*	1904.30 (3.40)	972.77 (1.13)
Presence of plant disease damage, 1=present			-773.06 (-1.91)*	1631.90 (1.33)	-983.07 (-2.36)**	1188.89 (0.96)	-755.67 (-1.83)*	-97.92 (-0.08)
Interactions								
DAP*DAP					-0.03 (-0.21)	0.06 (0.42)	-0.08 (-0.55)	0.07 (0.45)
Seed rate*Seed rate					1.61 (1.17)	2.39 (1.38)	3.57 (2.47)**	5.45 (2.92)***
Weed timing*Weed timing					-22.14 (-1.62)	-7.12 (-0.35)	-17.00 (-1.18)	4.97 (0.25)
Seed rate* DAP							1.17 (2.80)*	1.51 (2.73)**
Improved seed*DAP							28.31 (1.51)	29.63 (1.30)
Seed rate* Improved seed							9.46 (0.18)	-7.15 (-0.12)
Weed timing*Seed rate							-10.87 (-1.86)**	-13.68 (-2.20)**
Constant	2884.99 (14.41)***	2069.87 (2.84)***	1100.93 (1.21)	485.01 (0.33)	1225.22 (0.68)	2631.66 (1.12)	4986.48 (2.20)**	9477.26 (2.91)***
R^2	0.54	0.85	0.60	0.86	0.63	0.87	0.69	0.91
Adjusted R^2	0.53	0.69	0.57	0.69	0.58	0.69	0.64	0.75
Joint F-test:								
for hh dummies	NA	[0.0118]	NA	[0.0583]	NA	[0.0783]	NA	[0.0676]
for DAP					[0.0375]	[0.4347]	[0.0402]	[0.0376]
for seed rate					[0.3152]	[0.3185]	[0.0050]	[0.0192]
for improved seed					NA	NA	[0.0000]	[0.0000]
for weed timing					[0.1220]	[0.7895]	[0.0195]	[0.0859]
for quadratic terms					[0.2213]	[0.3689]	[0.0349]	[0.0233]
for interaction terms					NA	NA	[0.0071]	[0.0444]
n	80	80	80	80	80	80	80	80

Notes: T statistics reported in parentheses (H_0:β_i=0: H_1:$\beta_i \neq 0$); p-value reported in brackets;
* denotes 10% significance; ** denotes 5% significance; *** denotes 1% significance.
[1] Models are specified with and without household fixed effects; NA = not applicable.

household-constant omitted factors affected both plots equally). The household dummy variables were jointly significant in explaining variations in yields, thus validating the hypothesis that some household-constant factor (likely farmer skill or rainfall) is correlated with yields. The mean yield on traditional plots fell from 2,885 kg/ha to 2,070 kg/ha with the inclusion of household FE, thus it may be possible that the improved seed/urea dummy in model 1, without FE, was picking up some of the omitted effects, thereby raising its impact on yields.

Model 2, Without FE. Model 1 demonstrated that the SG package explained 54 percent of the variation in yields; however, model 2 revealed that yield variation can be further explained by controlling for red soil, the incidence of disease, as well as by separating out the elements of the SG package. The magnitude of the coefficient on seed type/urea fell from 2,685 kg/ha to 2,452 kg/ha. Improved seed/urea, DAP, red soil and the presence of plant disease were significant. Each additional kg/ha of DAP yielded an additional 11.80 kg/ha of maize. Recall that the dummy for red soil represented 75 out of 80 plots, thus, although it contributes to the fit of the model, its explanatory power is questionable. In addition, as with other variables, red soil may be correlated with omitted factors (e.g., rainfall, management), and thus may not exclusively explain the relationship between soil and yield.

Model 2, FE. When household FE was estimated many regressors lost their significance, but especially noticeable was the effect on DAP. DAP lost all of its explanatory power which suggests two explanations: one, that the omitted effects were positively correlated with DAP and therefore, DAP was picking up the effect of these other variables before FE was estimated; or two, that DAP is so highly correlated with the omitted effects that it is not possible to separate out the separate effects. There may be a time lag present in which the farmer must discover the optimum level and mix of fertilizer on his or her plot as well as the appropriate timing and level of complementary inputs and practices. Accessibility to extension services can reduce this learning curve to some extent.

The number of weeks between planting and first weeding is not significant, although it contributed to the fit of the model. Different specifications of weed timing were entered in the model, but none of the slope coefficients were significantly different from zero. A dummy variable to represent the recommended 4 weeks between planting and weeding was specified. The number of weeks that a farmer exceeded the recommended weed week, if a farmer was late in weeding, was also entered. On average, weeding was about a week late on both SG and traditional plots. A similar variable for early weeding was also entered, but it also failed the hypothesis test that the slope coefficient was significantly different from zero.

Model 3, Without FE. Model 3 adds quadratic terms to the specification in model 2; however, among the three variables--seed density, timing, and DAP--the net effect of DAP (linear plus quadratic term) was the only variable that was significant.

Model 3, FE. With the addition of fixed effects, none of the three terms--seed density, timing, and DAP--were significant. SG participation remained significant, as did red soil and presence of disease damage. When the model was estimated with FE, the presence of plant disease and weed timing were no longer significant. Overall, the addition of quadratic terms were not jointly significant and therefore added very little explanatory power to model 2.

Model 4, Without FE. The interaction terms--seed rate and DAP, improved seed and DAP, seed rate and improved seed, and weed timing and seed rate–were jointly significant as were the quadratic terms. DAP, seed rate, weed timing, and use of improved seed were all jointly significant when combined with their respective quadratic and interaction terms. However, this model may suffer from biased estimates because it does not control for the omitted household fixed effect.

The total effect[57] of DAP on yield is a function of the interactions of DAP combined with seeding rate, and improved seed, as well as a function of the level of DAP (given a nonlinear relationship between DAP and yields exists). The total effect of weed timing (how an additional week later than the planting date affects yields) is 180 kg/ha. It was tested whether the effect of weed timing had a different impact on yield depending on whether improved or local seed was used; however, a hypothesis test of the slope coefficient of the interaction of weed timing and improved seed was not significantly different from zero. The total effect of seeding rate (one additional kg/ha of seed) was significant and negative: -31 kg/ha for local seed and -21 kg/ha for improved seed. The total effect on yield of one additional kg/ha of DAP was -1 kg/ha for local seed and 27

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[57]The total effect of any variable (by how yields will change with an additional unit of that variable) is calculated by adding up the partial derivatives of the separate interactive effects which means the coefficient of an interactive variable is multiplied by the partial derivative of the variable in question. For example, for DAP, the coefficient of DAP*DAP is 0.07 so 0.07 is multiplied by the mean of DAP (the result of the partial derivative of DAP*DAP with respect to DAP). The partial derivative of DAP*seed rate would also be added to the sum of partial derivatives, 1.51*(the mean of seed rate).

kg/ha for improved seed. The total effect of improved seed was 2,440 kg/ha higher than the predicted yield achieved with local seed.

Model 4, With FE. Model 4 with fixed effects is the preferred model. The FE specification with the inclusion of additional interaction terms improved model 3's explanatory power (the joint F test of the interaction terms was significant). In contrast to model 3, the joint effect of the quadratic terms was also significant in model 4. Aside from weed timing, all other total effects--DAP, seed rate, and improved seed--were jointly significant.

The total effect of DAP (at the mean level of DAP and seeding rate) was 3.25 kg/ha less yield per kilogram of DAP when local seed was used, and 26.35 kg/ha additional yield per kilogram of DAP when improved seed was used. Thus, at the means of seeding rate and DAP and with the use of local seed, yields decrease with an additional kilogram of DAP. If farmers using the local maize variety increased their DAP application to 121 kg/ha, from the mean of 98 kg/ha, *ceteris paribus*, then the total DAP effect on yield would be positive (the response rate from an additional kilogram of DAP on yield would be positive).

Model 4 reveals that if local seed is used, then maximizing yields given the use of DAP is dependent, not only upon the level of DAP, but also upon the seeding rate. At the means of DAP and seeding rate, the total effect of DAP on yields is negative if local seed is used; however, if seeding rate is increased (and DAP is kept at its mean), the DAP effect on yields is positive. If, for the local seed users, the level of DAP was held at its mean (97.9 kg/ha) and the intensity of seeding rate increased to its 75th percentile, 36.60

kg/ha (the mean is 30.20 kg/ha), then the total effect of DAP is positive: an additional kilogram of DAP results in an additional 6.40 kg/ha of maize (Table 6.14).[58]

This result is corroborated by the fact that plant density can be significantly increased with the use of DAP, but not if no fertilizer is used. Although the seeding rate of local and hybrid seed users exceeded the recommended rate (25 kg/ha), the resulting plant density on the SG and traditional plot was much lower than the recommended density (roughly 25,000 plants/ha compared to the recommended 44,0000 plants/ha). Perhaps both the local and hybrid seed were not the high quality expected by the extension service and therefore never germinated. Thus, given low seed quality, the seeding rate should be increased, as recommended by model 4.

Table 6.14 Yield Response from Mean Level of DAP (98 kg/ha) and Varied Levels of Seeding Rate, kg/ha

Seed Type	Mean (30.20 kg/ha)	Mean of 25th percentile (22.40 kg/ha)	Mean of 75th percentile (36.60 kg/ha)
Local	-3.26 kg/ha	-15.06 kg/ha	6.40 kg/ha
Hybrid	26.34 kg/ha	26.34 kg/ha	36.00 kg/ha

Source: Calculated from coefficients obtained from table 6.13 and means obtained from table 6.12.
Note: The 25th percentile represents the lowest quarter of seeding rates observed, the 75th percentile represents the highest quarter.

If farmers are using hybrid seed and urea and 98 kg/ha DAP is applied, then the total DAP effect at the 25th percentile of seeding rate is 14.5 kg/ha and 36 kg/ha at the 75th percentile. Thus, if a farmer shifts from using local seed to a hybrid seed/urea technology

[58] If farmers are using local seed, fertilizer at its mean, 98 kg/ha, and the seeding rate is reduced to the 25th percentile, 22.40 kg/ha, then the total effect of an additional kilogram of DAP would result in reducing yields by 15 kg/ha.

package, holding seeding rate at its 75th percentile (37 kg/ha) then maize yield will increase by roughly 30 kg/ha (the difference between 36 and 6.4 in table 6.14).

The fertilizer response ratio from table 6.14 can be used to estimate VCRs for adopting DAP (maintaining use of local seed). If the fertilizer response ratio for local seed users is 6.40 kg of maize for a kilogram of DAP (with seeding density at its 75th percentile) the VCR at 1997 prices is 1.34, below the recommended threshold for profitability of 2. Fertilizer prices would have to drop by 33 percent for a VCR of 2. Chapter 8 will delve more into the profitability of adopting the high-input technologies, but this exercise hints that real profitability gains will be had primarily from adopting hybrid seed and also by repeated use of the technology for a few years in order to achieve the optimal combination of improved seed, seeding rate, and level of DAP.

The partial effect of the interaction of seeding rate and DAP on yields is the only DAP interaction that is significant (at 1 percent significance). The partial effect of seeding rate interacted with DAP at their means is 45.60 kg/ha additional yield, *ceteris paribus*. At the 25th percentile of seeding rate (22.40 kg/ha), the partial effect is 33.80 kg/ha additional yield *ceteris paribus*. At the 75th percentile of seeding rate (36.60 kg/ha), the partial effect is 55.26 kg/ha of additional yield, *ceteris paribus*.

The total effect of seeding rate was significant and negative: yields fell by 45 kg/ha with an additional kg/ha of seed for improved seed users, and fell by 38 kg/ha with an additional kg/ha when local seed was used. The seeding rate should increase (holding other inputs at their means) to at least 35 kg/ha for both types of seed if the total effect of seeding rate is to make a positive contribution to yields (average seed rate was 26 kg/ha and 34 kg/ha for SG and traditional plots, respectively). In every model specification thus far, seeding rate has not been significant, but the joint effect of seeding rate with DAP, weed timing, and improved seed is significant. If the level of seed is held at its mean (30.2 kg/ha) then DAP use would have to increase to 125 kg/ha for the local maize seed and 130 kg/ha for the hybrid maize seed before a positive total effect on yield is possible.

The total effect of improved seed was 2,572 kg/ha higher than the mean achieved using local seed. An interaction between red soil and improved seed was entered, but it failed the hypothesis test that its slope coefficient was significantly different from zero.

In sum, the yield model demonstrated that interactions between inputs and management practices can be important factors in explaining yield variations. Model 4 suggests that the level of application of seed, fertilizer, and type of seed may require some adjustment in order to achieve a complementary balance between inputs that will maximize yields. In addition, the interactions between various inputs and improved seed, specifically, were also important in demonstrating that the use of improved seed may require unique management practices, practices that differ from those used in producing maize using local seed. It is thus concluded that it is imperative that a high-quality extension service accompany the development of input markets for fertilizer, hybrid seed, and credit if real productivity gains are to be attained in the near future.

6.5 Conclusion

The objective of this chapter was to determine to what extent the high-input technologies were significant in raising yields for the SG participants. If so, then research emphasis on the organization of credit and input markets is warranted (see chapter 7)--to ensure that use of the new technologies is increased and sustained.

A fixed effects econometric yield equation was used to determine the relative importance of the SG-recommended combination of inputs and respective management practices in explaining yield variations across SG plots. The yield model revealed that the use of improved seed and urea significantly contributes to substantial yield increases above the local maize variety. In addition, interaction effects are important to maximizing yield. Given that weed timing is a significant determinant of yields, it is also important that farmers are able to plant during the optimal time such that the timing of flowering coincides with the timing of maximum rainfall. Abede (1992) reported that late planting often compromises the quality and timing of weeding, thus indirectly the sequencing of events, even back to delivery of inputs, is crucial to maximizing yield growth from the new inputs. As shown earlier, the NEP relies on various institutions (banks for credit, multiple companies for fertilizer, the National Seed Enterprise for seed) to coordinate input delivery which can mean delays. In addition, the NEP may not necessarily have the financial means to step in to provide transport and collect fertilizer if it looks like its distribution network is going to be delayed.

A second finding in this chapter was that it appears that the SG participants were better suited to use the high-input technologies more efficiently than the broader population and thus this may effect the efficient use and expansion of the high-input technologies. It was revealed that SG participants and fertilizer users, in general, have significantly higher levels of assets such as land, labor, livestock, and education. Statistical and econometric analysis demonstrated that yields are sensitive to management practices such as weed timing, planting date, row spacing, seeding rate, and level of inputs. Given that the broader population is not as well educated (22 percent) as the SG farmers (95 percent), and that the NEP extension agents may not be able to provide the same level of supervision it is questionable whether the new technologies will see the same impressive yield increases as observed on the SG plots.

Given that the high-input technologies can significantly increase yields, a comparative analysis was used to determine what characteristics of the organizational structure of the SG program may have led to the efficient delivery of inputs and information that could have complemented farmer knowledge. It was revealed that the nature of being small-scale and reducing the reliance on other institutions (for credit, for example) may have facilitated timely delivery of input and a high-quality extension message.

The following chapter will delve more deeply into the ability of the input market, and the NEP specifically, to provide quality extension, accessible credit, and timely and affordable inputs to smallholders across Ethiopia.

CHAPTER 7

PERFORMANCE OF THE INPUT MARKETS: A FOCUS ON FERTILIZER

The SG technologies were tremendously successful in increasing yields and raising net incomes and returns to labor for SG program participants in Ethiopia. Ethiopia is currently trying to scale-up the SG success, through its national extension program. However, as demonstrated in chapter 1, many SSA countries have had limited success in achieving long-term productivity gains through high-input use, because as governments expand their agricultural programs they often overextend their financial means and eventually are forced to withdraw support. Farmers are then unable to rely on the market to sustain their high-input packages because the input, credit, and output markets are insufficiently developed and "disadoption" follows. Sustained and expanded use of new technologies is predicated upon how well the three functions of extension, credit, and input delivery, as well as output markets meet the needs of farmers. This chapter will determine whether these functions--but particularly fertilizer delivery--of the input market met the needs of Ethiopian farmers in 1998, one year after the SG withdrew from production demonstration programs.

Fertilizer (nitrogen and phosphate) is an important ingredient to increased productivity growth in Ethiopia. Research trials have proved the success of fertilizer in raising yields (ADD/NFIU 1992), and evidence from farmer experience with fertilizer strengthens this conclusion. As shown in the last chapter, efficient fertilizer use on farms in Jimma was dependent upon appropriate complementary practices, namely seeding rate and weeding timing.[59]

There are limits to expanding yields with fertilizer use when local maize varieties are used, however. As shown in the yield model in the last chapter, the use of improved seed and urea (holding all else constant) significantly increases yields. When improved seed is combined with fertilizer and appropriate (high) plant densities, yields can be further increased (Schulthess and Ward 1999). Although not directly addressed in this research, it is generally agreed that the improved seed market needs to be improved to complement the fertilizer and input credit markets for sustained productivity growth to take hold in Ethiopia. In 1998 there was ample anecdotal evidence that the hybrid maize seed was poor quality and also that there was a severe supply constraint (GMRP 1998). Improved seed distribution is dominated by the parastatal, the Ethiopian Seed Enterprise which supplied an estimated 47 percent of total demand in 1999 (Howard 1999). The only other distributer is Pioneer Hy-bred International Inc.[60] who supplied an estimated 5 percent of

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[59]In another example, Gordan et al. (1995) found that in Awassa, Oromiya Region, maize yields increased from 20 to 50 quintal/ha as fertilizer increased from 50 to 200 kg/ha, using local seed (and holding all else constant). Additionally, the net yield increase from fertilizer can raise incomes: cash income increased 31 percent with the use of 100 kg/ha DAP and 50 kg/ha urea in Ada district, Oromiya Region, keeping prices constant (Belete et al. 1992).

[60]In 1991 Pioneer and the Ethiopian Government established a joint venture. In 1998 Pioneer sold roughly 1,000 MT to the Seed Enterprise, but most of its sales went to Kenya. Pioneer stated in 1998 that it had the capacity to fill market demand in Ethiopia, but perhaps the constraint was that its retail price was higher than that charged by the National Seed Enterprise. In 1998 Pioneer was experimenting with selling seed on consignment (Woreda. 1998. Director of Operations, Pioneer, Ethiopia, personal

the market in 1999 (Howard 1999). The government distributes the seed through the NEP, leaving little to no seed supply for the open market. Thus, farmers enter or stay in the NEP if they desire to use the high-input technologies.

The cost of fertilizer represented roughly 30 percent of the total cost of adopting the SG high-input technology and improved seed represented 8 percent (including the value of labor) (calculated from data in Howard et al. 1999). Reducing the cost of fertilizer *ceteris paribus* will improve the profitability of fertilizer, thus, improving the accessibility of the high-input technologies to a broader population--to farmers in less favorable agro-ecological zones, and with lower levels of assets. However, fertilizer consumption is a function not only of cost, but of a host of attributes relating to access to fertilizer markets--timely delivery of inputs, quality extension, and credit. This chapter will address all issues, but will concentrate on evaluating whether costs can be reduced in the fertilizer subsector.

This chapter will follow a step-by-step analytical method to identify[61] and quantify potential cost reductions in the fertilizer subsector. Important market attributes are identified through qualitative responses[62] from survey respondents in the 1998 GMRP

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communication).

[61]Identification of important performance dimensions is in part based upon past research: international donors (World Bank, 1992; International Fertilizer Development Center, 1995; Economics Department of the University of Addis Ababa 1994-1998; Grain Market Research Project 1995-1998) have reported on the potential for cost-reduction in the Ethiopian fertilizer subsector since the rise of the TGE in 1991.

[62]Respondents vary, including importers, wholesalers, independent retailers, transporters, as well as officials of Service Cooperatives, and government officials in the National Fertilizer and Inputs Agency and the Ministry of Agriculture.

Input Subsector Survey. A fertilizer cost-build up, reinforced with secondary data on f.o.b. (free on board)[63] international fertilizer prices and Ethiopian transport costs, will be used as a guide to determine how much costs could be reduced in the system at both the import and distribution stages.

In the next chapter the identified quantified cost reductions throughout the subsector will be inserted into farm budgets and the resulting net income will be simulated. The town of Jimma, 450 kilometers south-west of Addis Ababa in Jimma Zone, Oromiya Region, is the selected maize area used to simulate changes in profitability because it is one location where the SG pilot program operated in 1997 and for which farm budgets were collected by Howard et al. (1999) for farmers that managed both a plot under the SG technology and a plot managed under traditional technologies and practices.

7.1 Defining Performance

'Good' market performance is subjective and characterized by numerous ill-defined, often unquantifiable measures. Evaluating the performance of a subsector is not an easy task for there are a wide range of performance measures and dimensions (Bain 1968; Sosnick 1964; and Brandow 1977). Brandow (1977:81) illustrates the quagmire economists face:

> Economists asked to appraise the economic performance of an industry have a difficult task. If they confine themselves to the elegant abstractions of rigorous general theory, they find few handles by which to grasp the inelegant real world and are

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[63]The price of an export loaded in the ship that will carry it to foreign buyers (Gittinger 1982).

> wholly unprepared for some of the institutional and dynamic characteristics of the industry. If they adopt the approach of industrial organization economics, they find standards imprecise, measurement both conceptually and empirically difficult, and judgement usually necessary to reach conclusions.

In accordance with Brandow's concerns, the theoretical method used in this analysis will not attempt to define a quantified index of performance measures or norms, but will use "judgement and relative comparisons" (Jesse 1978) to evaluate the performance of the fertilizer subsector. The methodology assumed here is that a degree of causality exists between market structure, conduct, and performance. That is, underlying institutions (rules of the game) and property rights, both choices of government, can effect the outcome of a market.

When performance of a subsector is evaluated it is commonly understood that first an established set of performance criteria need to be agreed upon by society. In general, the marketing functions that are useful to society should be performed at the lowest possible cost. Although a wide variety of performance dimensions exist, there are common concerns. Some of the key performance criteria of the fertilizer subsector are: reduced costs in the sector, price transparency, timely delivery, adequate supply, product suitability, and adequate level of profit rates. More broadly: (1) Production decisions should be responsive qualitatively and quantitatively to consumer demands (aggregate demand equals aggregate supply, and the sector is low-cost); (2) Operations of producers should be progressive; that is, there should be increased output per unit of input over time;

and (3) Operations of producers should facilitate stable, full employment of resources (Scherer 1980).

7.2 Fertilizer Financial Import Parity Price

A financial import parity price[64] is computed from a cost build-up: an accounting technique designed to identify the cost components in one subsector of the economy. In the case of the fertilizer sector in Ethiopia, it adds all costs and margins from the port of export to retail sale, including the f.o.b. price at the international port of export, shipping, port fees, stevedoring, transport, storage, handling, as well as margins and interest.

One benefit of the financial import parity price framework is that it allows for a detailed inspection of the costs and the magnitude of the costs within a subsector. The financial import parity price can be used to "challenge maddening myths about agricultural marketing systems, which are widely believed in certain groups" (Holtzman 1989). For example, a common misconception is that marketing middlemen serve no productive purpose and receive excessive returns (Holtzman 1989). The financial import parity price identifies the productive, value-added activities that occupy marketing agents. Marketing agents provide time, place, and form utilities (i.e., assembly, transport, and storage). The financial import parity price thus validates marketing agents by identifying the real cost of engaging in marketing activities.

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[64]Financial import parity price is the term used to refer to a calculated domestic market price under competitive market conditions and in the absence of taxes and subsidies. It is thus assumed that "competitive market" domestic prices are not necessarily available.

The financial import parity price answers the question: Does the cost of importing fertilizer and delivering it to farmers reflect the cost of doing business in Ethiopia? It is easy to test the validity of the technique--if the financial import parity price diverges significantly from observed fertilizer retail prices then some costs in the system have not been correctly identified (e.g., perhaps excessive returns exist).

There are benefits and limitations of a financial import parity price approach to examining market performance. One limitation is that it is a static picture of the "typical" costs associated with a market for a specified unit of production. It is not designed to calculate costs over time or for different units of production. Therefore, it may not reveal the real cost associated with doing business in an environment subject to uncertain and changing government policy and demand that is subject to fluctuations in the weather. However, one benefit of the financial import parity price is that it enables researchers to identify the major cost components in the marketing chain. Once identified, further investigation can determine whether it is possible to target these areas through investment or institutional change to reduce costs in the subsector.

Tables 7.1 and 7.2 outline the price structure of delivering DAP and urea to Jimma Zone in the Oromiya Region in 1998 (detailed notes provided in Appendix 3). The financial import parity price is based upon a "typical" timing of imports and distribution of imported fertilizer by an integrated retailer. If fertilizer changes hands from importer to wholesaler to retailer additional administration costs would be added to the budgets. An international contract is signed any time from September to December and delivery occurs from February to May. Another specification is that the financial import parity price is

Table 7.1 Calculation of 1998 Financial Import Parity Price for DAP (Notes on the following page.)

	Assab (2)				Djibouti			
	Low-price Scenario		High-price Scenario		Low-price Scenario		High-price Scenario	
	US$/MT	Birr/qtl	US$/MT	Birr/qtl	US$/MT	Birr/qtl	US$/MT	Birr/qtl
1. DAP F.O.B. (1)	224.89	161.92			224.89	155.42		
2. Freight (3)	14.25	10.26			14.25	9.85		
3. Insurance (3)	0.75	0.54			0.75	0.52		
4. C.I.F. Assab/Djibouti (4)	**239.89**	**172.72**	**251.95**	**173.85**	**239.80**	**165.46**	**251.95**	**173.85**
5. Bank Charges @ 1.2% c.i.f. (5)	3.00	2.16	3.15	2.17	3.00	2.07	3.15	2.17
6. Transit Charge (6)	2.61	1.88	2.61	1.88	3.30	2.28	3.30	2.28
7. Port Charges (7)	1.00	0.72	1.00	0.72	1.12	0.77	1.12	0.77
8. Stevedoring (8)	6.50	4.68	6.50	4.68	6.00	4.14	6.00	4.14
9. Crainage (9)	2.00	1.44	2.00	1.44	2.00	1.38	2.00	1.38
10. Equipment in Hold (10)	0.27	0.19	0.27	0.19	0.27	0.19	0.27	0.19
11. Bagging (11)	4.25	3.06	4.25	3.06	4.25	2.93	4.25	2.93
12. Losses @ 0.5% c.i.f. (3)	1.20	0.83	1.26	0.87	1.20	0.83	1.26	0.87
13. Administration Salaries (3)	0.15	0.10	0.15	0.11	0.15	0.10	0.15	0.10
14. Interest (12)	6.30	4.35	6.61	4.56	6.29	4.35	6.61	4.56
15. Procurement Margin (13)	2.90	2.00	2.90	2.00	2.90	2.00	2.90	2.00
16. Distributor Price FOT (14)	**270.06**	**186.34**	**282.65**	**195.03**	**267.38**	**186.49**	**282.96**	**195.24**
17. Inland Freight Cost to Nazreth (15)	34.50	23.80	34.50	23.80	47.14	32.53	47.14	32.53
18. Unloading into Store (16)	0.72	0.50	0.72	0.50	0.72	0.50	0.72	2.00
19. Cost Delivered to Warehouse (17)	**305.28**	**210.65**	**317.87**	**219.33**	**318.14**	**219.52**	**330.83**	**228.27**
20. Storage for 2 months @ 0.35 Birr/qtl/mo (18)	1.01	0.70	1.01	0.70	1.01	0.70	1.01	0.70
21. Interest for 2 months (12)	4.20	2.90	4.41	3.04	4.20	2.90	4.41	3.04
22. Loading into Truck (16)	0.72	0.50	0.72	0.50	0.72	0.50	0.72	0.50
23. Wholesale/Retail Margin - 2 Birr/qtl (13)	2.90	2.00	2.90	2.00	2.90	2.00	2.90	2.00
24. Wholesale Price, Nazreth (19)	**314.12**	**216.74**	**326.92**	**225.57**	**326.98**	**225.61**	**339.87**	**234.51**
25. Transport to Jimma, 444 km @ 0.046 Birr/qtl/km	29.60	20.42	29.60	20.42	29.60	20.42	29.60	20.42
26. Unloading into Store	0.72	0.50	0.72	0.50	0.72	0.50	0.72	0.50
27. Retail Price, Jimma (20)	**344.44**	**237.67**	**357.24**	**246.50**	**357.30**	**246.54**	**370.20**	**255.44**

Notes (same calculations for urea)

(1) For DAP, the low c.i.f. price is the actual c.i.f. price received by one importer in 1998, the high-price scenario is the highest price received among all importers (the c.i.f. price received on 38 percent of 1998 imports). For urea, the low c.i.f. price is the actual c.i.f. price received on 50% of the urea imports in 1998, f.o.b. Egypt (NFIA 1998).
(2) The exchange rate in 1998 for Assab was fixed at US$/Birr 7.20 and in Djibouti it was the market rate, US$/Birr 6.90, the average for Jan.-Jun. 1998.
(3) Kassahun Aberu, personal communication, August 1998, Addis Ababa.
(4) Sum of lines 1.-3.
(5) Service fee charged by banks for transferring money from an Ethiopian to a foreign bank.
(6) Fee charged for the management of the ship while it is in port. A fee of $1.50/MT is charged on all shipments.
Assumes that 25% of fertilizer is stored at the port for up to 30 days at Assab and 45 days at Djibouti (these are the grace periods at these ports during which no additional storage fees are charged). US$ 7.20/MT is charged on the 25% left in storage.
(7) Paid to port authority on a tonnage basis.
(8) Charge for unloading cargo from the ship to the dock by either ship crane or shore crane.
(9) Rent of either ship cranes or port cranes.
(10) Equipment in hold refers to excavators needed to mix DAP while it is in the ship's hold. Excavators are not needed for urea. (Kassahun, personal communication, August 1998).
(11) The cost of bagging does not include the price of the bag. The cost of the bag is included in the f.o.b. price.
(12) Interest @ 10.5% per annum for 3 months on 100% c.i.f. It is estimated that it takes roughly 3 months between the time fertilizer is ordered until it arrives at the port. Interest is also paid for the 2 months while the fertilizer is stored in Nazreth.
(13) Estimated at 2 birr/quintal each for importer margin and retail/wholesale margin. GMRP Fertilizer Subsector Survey 1998 and NFIA 1996.
(14) Sum of lines 4-15.
(15) Nazreth is the central distribution point for most fertilizer that is destined to the Amhara, Oromiya, and Southern Regions. It is the first point of storage for most fertilizer that is not stored at the port. Assab-Nazreth is 784 km at a rate of US$ 0.044/MT/km. Djibouti-Nazreth is 827 km at a rate of US$ 0.057/MT/km. Only truck-trailers are used on the Assab or Djibouti routes.
(16) Unloading and loading is 0.50 Birr/quintal.
(17) Sum of lines 16-18.
(18) Assumes a typical scenario--fertilizer is stored for 2 months in Nazreth warehouses before shipped to final destination.
(19) Sum of lines 19-23.
(20) Sum of lines 24-26.

Table 7.2 Calculation of 1998 Financial Import Parity Price for Urea

	Assab				Djibouti			
	Low-price Scenario		High -price Scenario		Low-price Scenario		High-price Scenario	
	US$/MT	Birr/qtl	US$/MT	Birr/qtl	US$/MT	Birr/qtl	US$/MT	Birr/qtl
1. DAP F.O.B. (1)	111.49	80.27			111.49	77.08	114.70	79.30
2. Freight (3)	13.00	9.36			14.25	9.85	35.00	24.20
3. Insurance (3)	0.51	0.37			0.51	0.35		
4. C.I.F. Assab/Djibouti (4)	125.00	90.00	147.43	160.15	126.25	87.29	147.43	101.93
5. Bank Charges @1.2% C.i.f. (5)	1.56	1.13	1.84	1.33	1.58	1.09	1.84	1.27
6. Transit Charge (6)	3.30	2.38	2.61	1.88	3.30	2.28	3.40	2.35
7. Port Charges (7)	1.00	0.72	1.00	0.72	1.12	0.77	1.12	0.77
8. Stevedoring (8)	6.50	4.68	6.50	4.68	6.00	4.15	6.00	4.15
9. Crainage (9)	2.00	1.44	2.00	1.44	2.00	1.38	2.00	1.38
10. Bagging (11)	4.25	3.06	4.25	3.06	4.25	2.94	4.25	2.94
11. Losses @ 0.5% C.i.f. (3)	0.63	0.45	0.74	0.53	0.63	0.44	0.74	0.51
12. Administration Salaries (3)	0.15	0.11	0.15	0.11	0.15	0.11	0.15	0.10
13. Interest (12)	3.28	2.36	3.87	2.79	3.31	2.29	3.87	2.68
14. Procurement Margin (14)	2.90	2.00	2.90	2.00	2.90	2.00	2.90	2.00
15. Distributor Price FOT	150.57	108.32	173.17	124.68	151.48	104.73	173.69	120.08
16. Inland Freight Cost to Nazreth (16)	34.50	24.84	34.50	24.84	47.14	32.59	47.14	32.59
17. Unloading into Store	0.72	0.50	0.72	0.50	0.72	0.50	0.72	0.50
18. Cost Delivered to Warehouse (18)	**185.78**	**133.66**	**208.51**	**150.02**	**199.34**	**137.82**	**221.55**	**153.17**
19. Storage for 2 months @ 0.35 Birr/qtl/mo (19)	1.01	0.70	1.01	0.70	1.01	0.70	1.01	0.70
20. Interest for 2 months (12)	2.19	1.58	2.58	1.86	2.21	1.53	2.58	1.78
21. Loading into Truck (17)	0.72	0.50	0.72	0.50	0.72	0.50	0.72	0.50
22. Wholesale/Retail Margin - 2 Birr/qtl (14)	2.89	2.00	2.89	2.00	2.89	2.00	2.89	2.00
23. Wholesale Price, Nazreth (20)	**192.59**	**138.66**	**215.70**	**155.31**	**206.18**	**142.55**	**228.76**	**158.15**
24. Transport to Jimma, 444 km @ 0.046 Birr/qtl/km	29.60	20.42	29.60	20.42	29.60	20.42	29.60	20.42
25. Unloading into Store	0.72	0.52	0.72	0.52	0.72	0.52	0.72	0.52
26. Retail Price, Jimma (21)	**222.91**	**159.61**	**246.02**	**176.25**	**236.50**	**163.47**	**259.08**	**179.08**

characteristic of a "free out" contract whereby stevedoring and bagging are covered by the cargo owner.[65] Costs are specific to a certain point of time and thus may not capture the seasonality observed in some prices. Hence, some of the variability in costs will be specified in a sensitivity analysis. The f.o.b. price is one line item that will be entered with a high and low level to represent the variation observed in f.o.b. international export DAP and urea prices throughout 1998. However, for the high-price scenarios for both Assab and Djibouti the financial import parity price will begin with the c.i.f. price and not include information on f.o.b. prices, insurance, and freight. It is assumed that freight and insurance remain relatively constant compared to f.o.b. prices, so a change in c.i.f. prices reflects a change primarily in f.o.b. prices.

In 1998 the weighted[66] c.i.f. (cost, insurance, freight)[67] Assab/Djibouti[68] price for imports was US$/MT 250 for DAP and US$/MT 147 for urea; however, there was great variability around these means (Table 7.3). The c.i.f. Assab/Djibouti DAP price ranged from US$/MT 240-252. The low price for DAP imports used in the financial import parity price represents the lowest c.i.f. price received in 1998 among all importers: EAL

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[65]This contrasts to a "liner out" contract where these activities plus the cost of bags are covered by the ship owner. One deviation from these definitions is that in the financial import parity prices specified the cost of the bags is included in the f.o.b. international prices.

[66]Weight based upon the quantity purchased that corresponds to the price. Prices quoted for larger quantities receive a larger weight.

[67]The c.i.f. price is the landed cost of an import at a certain location, which includes international freight, insurance, and handling costs (Gittinger 1982).

[68]1998 imports primarily arrived in Djibouti due to the conflict with Eritrea.

imported 25,000 MT with IDA funds at a c.i.f. price of US$/MT 240 (Table 7.3). The highest c.i.f. price used in the analysis for DAP was US$/MT 252, received by both AISE and Guna for a total of 108,371 MT (38 percent of total DAP imported) in contracts funded by the EU, Italy, and FDRE (NFIA 1998).

Table 7.3 Quantity of Fertilizer Imports and C.I.F. Djibouti/Assab[1] Price by Importer and Source of Funds, 1998

Company	Shipment	DAP		Urea	
		MT	C.I.F. (US$/MT)	MT	C.I.F. (US$/MT)
Public Sector				35,437	
AISE	1	58,000	251.95	10,437	263
	2	10,371	251.95		
	3	35,000	245.00		
	4	26,000	249.63		
	5	15,000	251.95	25,000	123.87
	Total	144,371		35,437	
Private		14,3000		59,000	
EAL	1	31,000	242.97		
	2	25,000	239.89		
	Total	56,000		0	
Ambassel[2]	1	25,000	249.63		
	2	17,000	249.55	19,000	147.50
	Total	42,000		19,000	
Guna	1	25,000	251.95	25,000	124.90
	Total	25,000		25,000	
Fertiline	1	20,000	246.23	15,000	144.42
	Total	20,000		15,000	
Total Qty/Weighted		287,371 MT	249.9 US$/MT	94,437 MT	147.43 US$/MT

Source: NFIA 1998.

Notes: [1] The specific port is not known, either Assab or Djibouti.

[2] The FDRE classifies Ambassel and Guna as private companies, but they are owned by the regional governments of Amhara and Tigray, respectively.

The c.i.f. urea prices in 1998 ranged from US$/MT 124-263. The high price of US$/MT 263 was for 10,437 MT (out of 94,437 MT) imported by AISE and funded by Japan. Japan required that fertilizer be bagged before it reached Assab or Djibouti. This high c.i.f. price under Japanese funds is treated as an exception (explained later) and not factored into the estimates of low and high urea c.i.f. prices used in the financial import parity price. For the financial import parity price for urea, the lower boundary used in the build-up, US$/MT 111 f.o.b. Egypt received by EAL which, with shipment and insurance, sums to US$/MT 125 c.i.f. in Assab. The high c.i.f. price for urea represents the average weighted urea c.i.f. price in 1998, US$/MT 147.

Using the financial import parity price just specified, a financial import parity price for DAP and urea was calculated to the central storage area, Nazreth, as well as for a retail market, Jimma (Table 7.4). On average, DAP and urea are marginally more expensive from Djibouti than Assab, primarily due to differences in ocean freight and inland transport rates. In addition, there is a spread of roughly 9-11 Birr/quintal for DAP and 16-17 Birr/quintal for urea depending upon whether it is a low or high c.i.f. price scenario, based upon differences in international f.o.b. prices.

Table 7.4 Nazreth Financial Import Parity Price, 1998

Port of Import	Scenario	DAP		Urea	
		US$/MT	Birr/quintal	US$/MT	Birr/quintal
Assab	low-price case	313.78	225.92	192.27	138.43
	high-price case	326.57	235.13	215.38	155.08
Djibouti	low-price case	326.94	226.04	206.16	142.54
	high-price case	339.83	234.95	228.74	158.15

Source: Tables 7.1 and 7.2.

7.3 Validating the Financial Import Parity Price

The price of fertilizer is a common indicator of performance. However, it is only useful if there is some reference point in which to judge: Does the retail price of fertilizer render it profitable for use by farmers (given yields and output prices); Does the price allow for returns to capital such that the market attracts investment; and Does the price accurately "clear" the market (does it equilibrate supply and demand)? Although this chapter will not address these issues in detail, the financial import parity price can reveal by how much market prices diverge from what is a "reasonable" (competitive) price–thus highlighting potential inefficiencies in the sector.

The DAP financial import parity price for Jimma Zone ranged from 238-255 Birr/quintal which is roughly comparable to the actual 1998 observed DAP price, 242 Birr/quintal. The urea financial import parity price for Jimma Zone ranged from 160-179 Birr/quintal, compared to 184 Birr/quintal observed in the market in 1998.

A sample of DAP and urea prices in 1998 in three zones in which the SG was active in production demonstration plots reveals that 1998 market prices fell considerably below the government prices facing the SG farmers in 1997. Thus, assuming constant yield and output price, profitability of fertilizer use would increase between 1997 and 1998 in East and West Shewa and Jimma, Oromiya Region. In 1998, DAP prices for credit ranged from 160-220 Birr/quintal compared to the 1997 government price of 241 Birr/quintal (Table 7.5). This decline can be partly attributed to liberalization of retail prices and the presence of competitive fertilizer auctions in Oromiya; however, it may also be attributed to the fact that some companies may have been liquidating their stock in 1998 after a couple years of carry-over.

DAP open market cash prices were higher than credit prices in East Shewa and West Shewa in 1998. This may be explained by the fact that cash prices are primarily prices offered by independent retailers that purchase their stock from integrated retailers who supply the credit programs.

Table 7.5 1997 and 1998 DAP Retail Prices For Three Zones in Oromiya, Birr/Quintal

	East Shewa		West Shewa		Jimma	
	1997 Govt. Price[2]	1998[3]	1997 Govt. Price	1998	1997 Govt. Price	1998
Credit[1]	241.0	160-220	247	222-226	255	242-255
Cash	241.0	218-232	247	225-240	255	220-254

Source: NFIA 1998 and 1998 GMRP Input Subsector Survey.

Notes: [1]Credit price is for NEP and regular credit.

[2]The 1997 price is calculated by the government. East Shewa government price was calculated for Debre Zeit. W. Shewa government price was calculated for Woliso. Jimma government price was calculated for Jimma town.

[3]The 1998 price represents a non-random sample for Ada wereda in E. Shewa, Woliso and Wonchi weredas in W. Shewa, and for the Jimma Zone.

Similarly for urea, the market prices in 1998 were considerably below the government price in 1997 in the three sampled zones in Oromiya (Table 7.6). The 1998 cash and credit market prices were equivalent in both East Shewa and West Shewa but were higher in Jimma. Credit prices in Jimma ranged between 187-198 Birr/quintal and cash prices ranged from 196-254 Birr/quintal.

The decline of DAP and urea prices over the course of two years may be a rough indicator that perhaps productivity gains were realized in the subsector relative to the system of government-established prices or a reflection of a decline in f.o.b. prices of fertilizer in 1998 relative to 1997 in key exporting countries; however, it provides no guidelines to whether prices in 1998 were higher or lower than the prices that could be reasonably be expected by society (under competitive market conditions). In order to

Table 7.6 1997 and 1998 Urea Retail Prices For Three Zones in Oromiya, Birr/Quintal

	East Shewa		West Shewa		Jimma	
	1997 Govt. Price[2]	1998 Market Price[3]	1997 Govt. Price[2]	1998 Market Price[3]	1997 Govt. Price[2]	1998 Market Price[3]
Credit[1]	226	155	232	161-163	241	187-198
Cash	226	155-173	232	162-180	241	196-254

Sources: NFIA 1998 and 1998 GMRP Input Subsector Survey.
Notes: [1]Credit price is for NEP and regular credit.
[2]The 1997 price is calculated by the Government. East Shewa government price was calculated for Debre Zeit. W. Shewa government price was calculated for Woliso. Jimma government price was calculated for Jimma town.
[3]The 1998 price represents a non-random sample for Ada wereda in E. Shewa, Woliso and Wonchi weredas in W. Shewa, and for the Jimma zone.

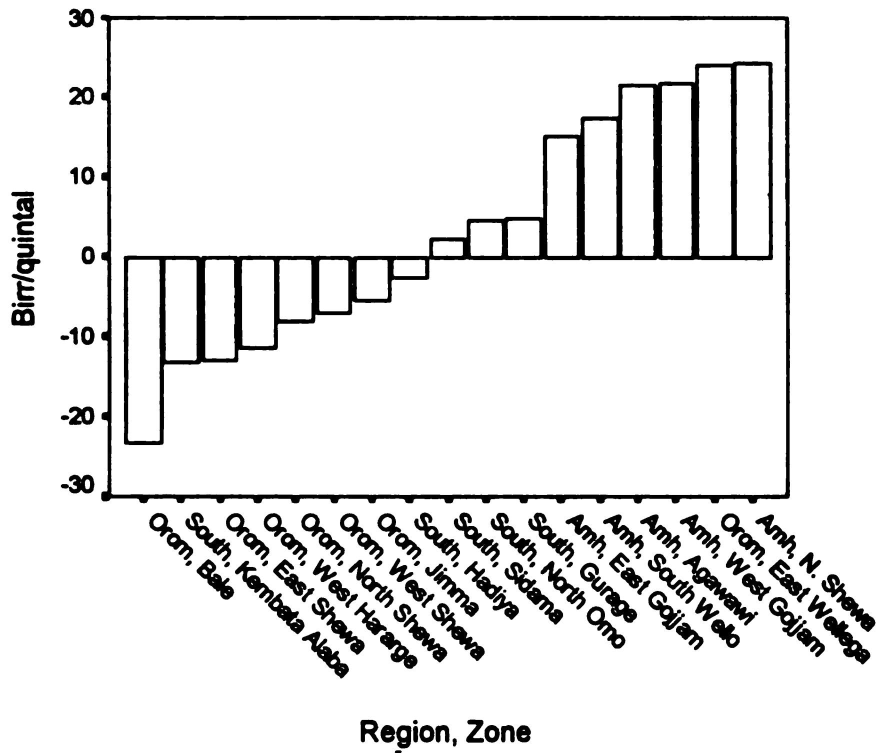
gauge the relative efficiency of fertilizer prices in 1998, the financial import parity price of DAP[69] is subtracted from the observed retail prices from the 1998 GMRP Input Subsector Survey and the difference is averaged across zones. In figure 7.1 the bars above zero represent the amount that the actual market price observed in 1998 exceeded the calculated financial import parity price and the bars below zero represent the opposite.

Overall, 1998 observed prices lay within 25 Birr/quintal of the financial import parity prices. Among the 17 zones surveyed, prices in nine zones lay above the financial import parity price and in eight zones prices lay below. Among the six zones where the observed price exceeded the financial import parity price by over 10 Birr/quintal, five were in the Amhara Region. This is not surprising because fertilizer distribution was not

[69]Transport costs plus unloading fees are added on to an average Nazreth wholesale price (average of the low-price and high-price scenarios) presented in Table 7.4 for DAP. The transport cost used was 0.04 cents/quintal/km, a rough average of freight rates from Nazreth to outlying retail markets. Unloading fees are 0.50 Birr/quintal.

competitive in the Amhara Region: the sole distribution rights of Ambassel potentially permitted it to charge monopoly prices.

Figure 7.1 Difference in Observed 1998 DAP Prices and Financial Import Parity Price in Select Zones
Note: Bars represent the financial import parity price subtracted from the market price.



There are also many zones that have prices that are below the calculated financial import parity price. One plausible explanation is that the fertilizer auctions held primarily in Oromiya were indeed very competitive and some companies may have offered below-cost prices in their bid. Another reason is that some companies had carry-over stock, and in an effort to liquidate their stock, charged below-cost prices. One importer/wholesaler called the 1998 retail market a "slaughter" (GMRP 1998). One reason that prices observed in some zones in the Southern Region may be lower than the financial import parity price is that farmers often dumped the unused portion of their NEP package on the market.

Another reason the financial import parity price may be less than the observed prices is because the financial import parity price calculation did not accurately capture transport costs within weredas. The calculated financial import parity prices represent the typical costs and timing of importing DAP and urea in 1998 to the major market town in each zone (not to rural areas outside the zonal capital). In 1998 fertilizer was delivered late in all surveyed weredas, thus the financial import parity price may not have accounted for increased transport rates that occur when delivery coincides with the May-July rains (GMRP 1998). In addition, the exact location of the observed market price within a wereda was not known for the financial import parity price calculation, so transport costs were calculated to the midpoint of the wereda and on paved roads. If the price was recorded in an outlying area, accessible only by a dirt road, then the resulting price will be higher.

Overall, this exercise revealed that the financial import parity price is not capturing all the costs in the system. Aside from the uncertainty of transport costs, there also may be large variances in margins across distributors. The different market structures across the country mean that larger returns may be captured by some distributors, whereas in other areas, the specified margin in the financial import parity price may be squeezed.

7.4 Reducing Costs in Importing

Private investment in the sector, and in importing specifically, has increased as a result of market liberalization. Several importers entered the business since 1993, including a private company, Fertiline, in 1998. In addition, new wholesalers have emerged on the market: Wondo, in the South, was a new entrant in 1998. Although, progress toward a more open import process has been made, qualitative evidence from 1998 revealed that perhaps the organization of imports hinders the development of a lower-cost import process. This section will provide evidence from the 1998 GMRP Input Subsector Survey as well as supporting empirical analyses to determine whether costs of importing can be reduced through reorganization of the process of imports.

Competitiveness in International Markets? It is typically assumed that small countries, like Ethiopia, are price-takers on international markets,[70] and that they therefore face market rates for its imports. However, it appears that the c.i.f. Assab/Djibouti DAP prices Ethiopia paid in 1998 were higher than market rates even after including insurance and freight.[71] The average f.o.b. price Jordan in 1998 was about US$/MT 216 which sums to an estimated c.i.f. price Djibouti of US$/MT 231 when freight is included. This is between 9-21 US$/MT less than the average c.i.f. Assab/Djibouti price Ethiopia actually

[70]Compared to large importers such as India and China that may have a strong bargaining position in international markets.

[71]With the exception of the bagged shipment funded by Japan, the urea prices appeared to be relatively more in line with market rates.

received for DAP in 1998 (Table 7.7).[72] Even if DAP comes from the US Gulf, Morocco or Tunisia, the cost of freight still brings the c.i.f. price to less than the maximum c.i.f. price Ethiopia paid.

One plausible explanation for the observed discrepancy is that the shipments procured are small and thus a premium is added onto the offer price. However, this is probably not the case because it is known that no price discounts are offered if a shipment increases from 20,000-100,000 MT (8 out 11 of Ethiopia's 1998 shipments were at least 20,000 MT) (Goss 1999).

Table 7.7 1998 International (Select Markets) F.O.B. DAP and Urea Prices and C.I.F. Assab/Djibouti Prices, US$/MT

Source of Fertilizer	Mean F.O.B. US$/MT	Standard Deviation	Minimum F.O.B. US$/MT	Maximum F.O.B. US$/MT	C.I.F. Assab or Djibouti[1]		
					Weighted average[2] US$/MT	Min US$/MT	Max US$/MT
DAP					249.90	239.89	251.95
US Gulf	201.60	5.15	192.00	212.00			
Jordan[3]	215.70	4.81	207.50	227.50			
Morocco	209.40	4.10	202.50	222.50			
Tunisia	212.00	2.82	208.00	222.00			
Urea					147.43	123.87	263.00
US Gulf	114.70	18.80	85.00	145.00			
Middle East	107.80	10.71	90.00	130.00			
Black Sea	83.10	9.55	65.00	100.00			

Sources: FMB Consultants Ltd. 1998 and NFIA 1998.
Notes: [1]Origin of fertilizer is not known.
[2]Average computed based upon the quantity imported at the corresponding price.
[3]Ethiopia imports much of its DAP from Jordan.

[72]This comparative analysis assumes that monthly f.o.b. prices do not vary more than 12 US$/MT.

Another explanation for the higher-than-market price is that international suppliers know that entering a sale with Ethiopia is risky because of the uncertainty surrounding when payment will be received, and hence, the delivery date. There have been occasions in Ethiopia where there is a delay of nine months to a year between the time a contract is signed with a foreign exporter and the fertilizer is shipped. The delay the supplier faces is due to the importer's tardiness in opening a Letter of Credit with an Ethiopian bank.[73]

The delay may be attributed to the hesitancy by the Ethiopian importer to import, given the uncertain distribution policies that may favor government companies or it may be due to administrative delays in receiving a loan, perhaps if a company is overextended (GMRP 1998). In 1998 three forex announcements were made for fertilizer imports, late September, late November, and late December (NFIA 1998). The Letter of Credit for these imports was not opened until mid-December, mid-February, and late April, respectively (NFIA 1998). This means there is a delay of two and a half to four months between the time an international supplier offers an importer a quote (in order for the importer to submit a bid) and the money for the contract is transferred. Once the money is transferred, shipping can take from 4 to 6 weeks.

The exporter anticipates this delay and signs a price that is higher than the current world prices to cover any potential price increase during the delay between when a price is quoted and the delivery is made (Goss 1999). From the observed Ethiopian c.i.f. DAP prices, descriptive statistics of the 1998 international f.o.b. prices, and a report from an international supplier that exports to Ethiopia (Norsk Hydro), a conservative estimate is

[73]Ethiopian importers are required by law to source fertilizer credit domestically.

that international suppliers will add a premium of up to 5 percent of the international f.o.b. price due to the uncertainty of doing business with Ethiopia.

Poor Coordination Between Aggregate Supply and Demand. Poor coordination between supply and demand is a reflection of inefficiencies in a sector. The quantity of imports is a function of NEP targets and availability of hard currency (i.e., donor funds), with little role for prices and effective demand to determine quantities imported.

Ethiopia has a history of national excess supply of fertilizer. In 1996 only 60 percent of the total amount of fertilizer available by all firms was sold (a carry-over of roughly 164,932 MT) and in 1997 companies continued to face problems of excess stock (Demeke et al. 1997).[74] In 1998 it is estimated that up to 26 percent of the fertilizer consumption was carry-over stock--16 percent for DAP and 58 percent for urea (author's computation based on NFIA data).

Excess supply mitigates the robustness of an economy because it is a signal that, perhaps due to lack of competition, too many resources are employed in a sector that could be fully employed elsewhere. Excess supply is costly in terms of the obvious storage and interest charges incurred, but equally important is the message it sends to potential entrants of the degree of uncertainty in the market. Uncertainty will keep potential entrants out of the market thus potentially keeping the market concentrated.

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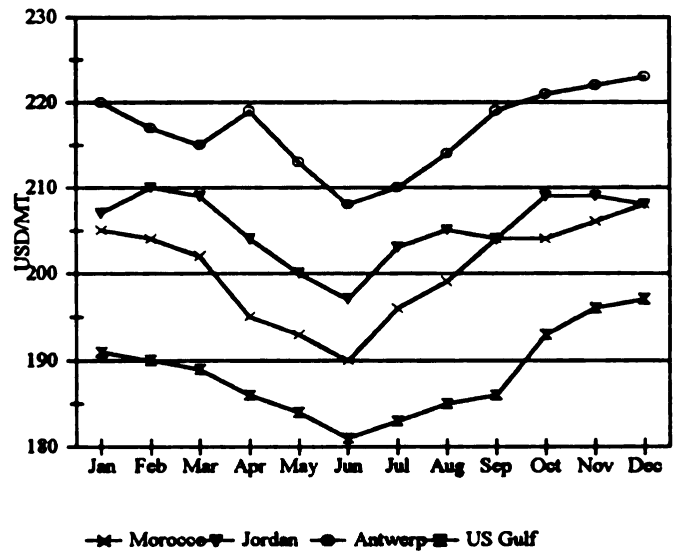
[74]EAL was particularly hard hit, for it only sold 30 percent of its supply in 1996. AISE and Ambassel fared better, selling 73 percent and 75 percent of their stock in 1996, respectively. However, a year later positions were reversed; AISE sold only 46 percent of its total supply and EAL sold a larger percent, 69 percent of its stocks. EAL dumped its stock by selling fertilizer to other distributors such as Ambassel and Dinsho at below retail-prices (Demeke et al. 1997).

High C.I.F. Price from Inflexible Timing of Imports. It will be determined whether the government's import policy–controlling access to import credit, as well as the timing of imports--raises the cost of imports. The timing of the government-controlled process is uncertain and often delayed. In 1997 it was reported that it took from 30-136 days for donors to approve funds, an additional 30-90 days for the government to float tenders, and another 75-109 days for a shipment to arrive (Demeke et al. 1998). In 1998 most importers agreed that the process had improved considerably, although there was still room for improvement (GMRP 1998). As mentioned earlier, the Letter of Credit for 1998 tenders was not opened for roughly two to four months after Ethiopian importers received their international quote (NFIA 1998) which can raise the offer price by international suppliers.

The second issue is that the inflexible timing of imports reduces the possibility that importers can take advantage of low-priced months on the international market. Not only is the process rigid, but inevitably delays occur (recall that the FDRE determined the timing of imports based primarily on the availability of donor funds). It is hypothesized that Ethiopia would be able to import at a lower c.i.f. Assab/Djibouti price if importers had the independence to determine the timing of their shipments. Over the 6-year period from 1993-1999 DAP f.o.b. prices in Morocco, Jordan, Antwerp, and the US Gulf exhibited a visible seasonal trend (Figure 7.2). Prices began to decline around March and April, were lowest around June, and then began to increase steadily to a high in December. For example, the f.o.b. bulk price in Jordan for DAP in May was roughly 13 US$/MT lower than the price in February. The spread is a little more pronounced for f.o.b. DAP prices in Morocco, a difference of 18 US$/MT between June and December (Figure 7.2).

Figure 7.2 Seasonal Index in Select World DAP Prices, US$/MT (Constant 1998)



Source: FMB Consultants 1999.

As seen in the previous section, Ethiopia pays a premium for administrative delays once a contract is signed with an international supplier. Before trying to organize how to improve the f.o.b. price (e.g., from Jordan, Morocco, or the US Gulf) through improved timing of imports, the possibility of improved bargaining with international suppliers should be explored. If Ethiopia could ensure that once a contract was signed with an international supplier, funds would be immediately transferred and delivery could proceed, then the average f.o.b. price may be reduced by 5 percent[75] (Scenario 1: f.o.b. price of DAP falls from US$/MT 225 to US$/MT 214) from the low-price scenario estimated in table 7.4 for DAP. In such a scenario, the financial import parity price calculated for Nazreth, imported through Djibouti, could be reduced by about 12 percent, from 247 Birr/quintal to 217 Birr/quintal (Table 7.8).

Assuming that Ethiopia could both improve its bargaining position and improve the timing of its imports, it is assumed that the contracted f.o.b. price could be reduced by 10 percent (Scenario 2: f.o.b. price falls from US$/MT 225 to US$/MT 202). In this case, the estimated wholesale price would be reduced by 15 percent, from 247 Birr/quintal to 209 Birr/quintal (Table 7.8).

Table 7.8 Nazreth Financial Import Parity Price for DAP Under Estimated F.O.B. Price Reductions

Scenario	Assab		Djibouti	
	US$/MT	Birr/quintal	US$/MT	Birr/quintal
Base scenario, low- and high-price scenarios	Low: 344.44 High: 357.24	Low: 237.67 High: 246.50	Low: 357.30 High: 370.20	Low: 246.54 High: 255.44
Scenario 1 Reduced Shipment Date Uncertainty (5% reduction in low f.ob. price)	302.16	208.44	315.11	217.43
Scenario 2 Reduced Shipment Date Uncertainty and Improved Timing (10% reduction in low f.o.b. price)	290.23	200.26	303.18	209.19

[75]5 percent is an average of the difference between the actual c.i.f. Djibouti prices received in 1998 and the calculated financial import parity price c.i.f. Djibouti price, and a rough figure provided by an international supplier (Norsk Hydro 1999).

Port Inefficiencies. Another issue relating to imports, port congestion, can raise the cost of importing fertilizer in two ways: first, congestion at the port prompts shipments on liner terms which can add a premium[76] to the f.o.b. price relative to charter terms; and second, port charges, including bagging and transport charges from the port are higher when the port is congested.[77]

Demeke et al. (1998) and the World Bank (1995) reported that demurrage charges in Assab may no longer be a problem because the port is increasingly efficient in off-loading cargo and thus contract terms should be switched from liner terms to charter terms. By 1998 many importers confirmed that Assab was relatively more efficient, but they reported that port inefficiencies were an issue in Djibouti (where fertilizer imports arrive since the beginning of the Eritrean-Ethiopian conflict in May 1998). As already mentioned, transport charges inland were higher from Djibouti than Assab due to the delays trucks faced in the port of Djibouti. Another import cost that is effected is that demurrage charges can be high in a congested port. The demurrage charge for a 25,000 MT ship can be as much as US$ 50,000 for a 5-day delay in unloading (2 US$/MT) (Kassahun 1998).

Offshore Bagging. Most fertilizer imported into Ethiopia is bagged in either Assab or Djibouti; however, on occasion, a donor will stipulate that fertilizer imports are bagged

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[76]A premium is paid to insure against the chance that demurrage charges will be owed to the ship owner by the cargo owner. Demurrage is the detention of a vessel or freight car beyond the time stipulated.

[77]Liner terms are advantageous to Ethiopian importers when the port is congested because the contract specifies that the ship owner pays the demurrage charges.

prior to arrival at these ports. Japan is one such donor. It is reported that a fertilizer shipment funded by Japan left the US Gulf in bulk, was transported to Antwerp for bagging, and then delivered to Ethiopia (Goss 1999). From 1993-1999 bagged f.o.b. prices were higher than bulk prices (Table 7.9). For example, if fertilizer comes from Morocco, bagged DAP is an average of almost 12 US$/MT higher than the bulk price (FMB Consultants Ltd. 1999). Although a rare instance, and only applicable for 10,000 MT (3.6 percent of total 1998 DAP imports), it is an unnecessary cost and can be avoided in the future.

Table 7.9 Comparison of Bulk and Bagged F.O.B. DAP Weekly Prices, January 1993 - February 1999, US$/MT

	Jordan		Morocco		Tunisia	
	Bulk	Bagged	Bulk	Bagged	Bulk	Bagged
Mean	207.0	220.2	198.7	210.6	199.8	211.1
Medium	208.9	222.4	200.1	211.1	202.5	212.4
Maximum	237.2	242.0	236.9	241.7	237.2	241.7
Minimum	175.1	190.2	156.7	164.9	156.2	156.2
Observations	261	261	240	240	238	238

Source: Compiled from FMB Consultants Ltd. 1999.

7.5 Reducing Costs in Wholesaling and Retailing

The organization of credit distribution may be largely responsible for preventing the development of a lower-cost fertilizer subsector, particularly at the wholesale and retail stages of the sector. Access to credit is increasingly important as the NEP expands to farmers who have fewer resources and lower incomes than SG participants, yet there were signs during the 1998 fertilizer season that the credit program was failing to meet farmers needs. Fertilizer application occurs during planting time, the lean season in most farmers' cash flow, and thus access to credit may determine whether a farmer uses fertilizer.

Credit problems are of two types: (1) the amount of the credit portfolio made available to different zones and credit programs (NEP and regular), and (2) problems associated with the way the credit is administered. The administration problems are linked to coordination problems between supply and demand, the time that agriculture personnel devote to processing credit (perhaps negatively effecting the quality of the extension message), and the regional government's use of the credit system to establish regional fertilizer monopolies that reduce competition and raise prices.

Survey evidence revealed that the total amount of credit is inadequate to meet both NEP and regular demand (GMRP 1998). Since 1997 credit has been guaranteed and administered by regional governments who determine allocations to zones who, in turn, determine allocations by wereda. Approximately 30 percent of farmers used fertilizer in 1995 when the NEP began and most were purchasing it with credit. With the expansion of the NEP the total credit available must now be divided between rapidly expanding NEP needs and regular credit for non-participants (disbursed through SCs).

For many weredas the total credit allocation has declined. For many other weredas the total amount of credit increased, but the amount allocated for regular credit declined substantially or disappeared entirely. One agronomist with the Bureau of Agriculture complained, "It is known that the land couldn't grow crops without fertilizer; however, the regular program peasants were not given a chance to access credit" (GMRP 1998). In the Oromiya Region one SC (non-NEP) reported that only 62 percent of its fertilizer demand was delivered, limited credit being the reason for the shortage (GMRP 1998).

Among the three zones in which SG farmers were surveyed by the GMRP and the Ministry of Agriculture in 1997, West Shewa was the only zone where total (NEP and regular) fertilizer credit increased, by 22 percent, between 1996/97 and 1997/98 (Table 7.10). During the same period, total fertilizer credit fell by 6 and 23 percent, respectively, in Jimma and East Shewa (Table 7.10).

Table 7.10 Fertilizer Credit in the Three SG Study Zones, Oromiya Region, '000 Birr

Zone	1993/94	1994/95	1995/96	1996/97	1997/98
Jimma	6,753.0	17,432.4	16,426.0	14,080.5	13,246.4
East Shewa	39,417.5	55,201.3	62,705.8	52,663.6	40,559.0
West Shewa	27,861.3	44,633.1	57,002.9	42,159.4	51,280.0
Oromiya Region Total	138,295.2	190,479.2	211,135.6	210,758.6	225,971.6

Source: Oromiya Regional Government 1998.

Note: All Oromiya zones are included under "Oromiya Region Total", not just the 3 listed here.

Overall, the NEP is gaining a larger share of declining credit resources in Jimma Zone. The amount of NEP fertilizer disbursed in the SG-participating weredas in Jimma increased by 61 percent and the amount of fertilizer that was disbursed through the regular program fell by 70 percent in the same time period. The amount of fertilizer sold on regular credit in Seka Cherkosa Wereda, Jimma Zone fell from over 2,000 quintals to zero quintals--thus farmers that were not participating in the NEP could not obtain credit from any government source (Table 7.11). The declining amount of fertilizer purchased on credit is not a concern except that most farmers do not purchase fertilizer except on credit (cash sales as a percent of total sales in the Seka Cherkosa were less than 1 percent (GMRP 1998)). Of the three SG-participating weredas in Jimma, Dedo is the only wereda that continues to extend a significant amount of fertilizer credit to farmers outside of the NEP.

Table 7.11 DAP and Urea Distributed on Credit in Kersa, Dedo, and Seka Cherkosa, Jimma Zone, Quintals

Wereda	Program	1995	1996	1997	1998[1]
Kersa	NEP	200.0	944.0	1,244.0	6,927.0
	Regular	na	na	na	2,389.0
	Total	200.0	na	na	9,316.0
Seka Cherkosa	NEP	168.0	1,149.3	1,271.0	1,996.0
	Regular	5,072.0	3,346.5	2,285.5	0.0
	Total	5,240.0	4,495.8	3,556.5	1,996.0
Dedo	NEP	20.0	293.8	9,087.5	9,715.0
	Regular	7,379.3	6,843.5	3,355.5	2,086.5
	Total	7,399.3	7,137.3	12,443.0	11,801.5

Source: GMRP Input Subsector Survey 1998.
Note: [1]Until August, 1998.

One reason for the declining credit volume to the regular credit program may be to rapidly expand the NEP. It is hypothesized that in 1998 credit was used to facilitate and even "bribe" farmers into joining the NEP (GMRP 1998). When the NEP becomes the only credit option or regular credit is severely limited, SG and NEP graduates and non-participants cannot obtain fertilizer credit unless they sign up for the NEP. Consequently, the transfer of technology may not be spreading as rapidly as intended.

Another reason for lower levels of regular credit may be that the government has toughen its credit requirements (e.g., use of police, confiscation of assets) and deny SCs (who administer regular credit) access to credit that have not met minimum repayment requirements. It was found that many farmers in West Shewa were denied credit for the highly profitable early maize crop due to a poor credit history (GMRP 1998). This issue leads into the second concern regarding the administration of credit: access to markets is tied to government credit, and two, the process of credit administration delays the delivery of fertilizer.

Coordination at the Farm and Regional Level. In an efficient market, prices adjust to equilibrate demand and supply; however, the Ethiopian fertilizer market is more representative of a command economy: regional governments directed the flow of product through its control of credit. Inevitably, as in many planned sectors, there were pockets of excess demand and excess supply across the regions of Amhara, Oromiya, and Southern in 1998. One source of the coordination problem is that at no level (except in the thin cash market) were prices allowed to equilibrate the market. Prices are decided based upon a predetermined quantity of fertilizer demand (either through the fertilizer auctions or privately negotiated with regional governments).

In the Amhara Region in 1998 there was sufficient fertilizer stock but the regional government's control of the market created an artificial shortage. Ambassel was the government-appointed distributor and no other companies were permitted to distribute. However, Ambassel faced a severe shortage of urea; and even though EAL claimed that it had positioned ample supplies in the region, many farmers were left without urea because additional supplies could not be arranged fast enough. Arranging for additional supplies is costly in terms of additional transaction costs (additional search costs as well as the potential premium paid for rapid delivery).

Given the limited ability of the NEP to accept all farmers into the NEP, due to the withdrawal of regular credit, and due to weak cash markets (e.g., the case of areas in the Jimma Zone), it is reported that many farmers who desired fertilizer and had the means to purchase some amount could not (GMRP 1998). There is a cost to excess demand--it is the foregone crop revenue that could be realized from increased fertilizer use.

As a consequence of the structure of credit, fertilizer prices played only a limited role in determining trade volumes. In fact, in some areas prices were not known at the time the down payment was collected. A typical scenario is that farmers were enrolled in the credit programs to the extent that credit was mobilized for the NEP, the down payment was collected, the demand estimates were forwarded to government, the government found a supplier (either through an auction or government-nomination), and only then was a price set for the fertilizer deliveries. In West Gojjam, Amhara, a SC began distributing fertilizer in April without knowing the price that the appointed supplier, Ambassel, was going to charge (GMRP 1998). The SC collected the down payment from farmers based upon the previous year's prices and was permitted to begin distribution. Ambassel set its prices in May (after distribution had begun) and instructed the SC to raise the prices to farmers (GMRP 1998). The SC refused and Ambassel threatened not to deliver the full amount.

In addition to excess demand at the farm level, there was evidence of excess supply at the farm level as well. Due to the lack of price information and a strong push by the government to expand the NEP, a standard package of inputs (100 kg/ha urea, 100 kg/ha DAP, and improved seed) was delivered to NEP farmers–even though it was often more fertilizer than desired. Farmers agreed to the package because in some areas there was no other source of fertilizer credit (or improved seed), but it is also reported that the DAs were coercive in enrolling farmers (GMRP 1998). Consequently, a thin secondary cash market for fertilizer (especially urea in the South) developed in 1998 in which farmers sold the unused portion of their fertilizer obtained on credit. Retailers outside of Addis complained that the "black market" for fertilizer was undercutting their sales and the illegal trade must be stopped (GMRP 1998). In North Shewa Zone, Amhara, farmers were reported to sell part of their NEP fertilizer package to obtain money for recreational purposes--primarily for local alcoholic drinks (GMRP 1998).

If effective demand and prices were permitted to play a larger role in guiding the allocation of fertilizer within the sector, it is possible that coordination between demand and supply could be improved and costs reduced.

Competition in Distribution. Obtaining access to government farm input credit programs is key to marketing fertilizer in Ethiopia. Additionally, integrated retailers preferred credit to cash sales because the government removes the risk of marketing for credit sales. The government pays the suppliers the full amount of a contract upon delivery, shifting the risk onto itself. However, access to credit is not open to all distributors[78]--government's efforts to restrict access to credit can result in a concentrated, high-cost market. In the Amhara Region, for example, the government used access to credit as a way to promote a monopoly of its favored company, Ambassel. Introduction of competitive influences in the market, through reduced barriers to access to government credit programs. Who distributes should not be a government decision.

The chapters on structure and conduct of the fertilizer market revealed that an array of market structures and corresponding pricing mechanisms were present in 1998. This raises the question: Is there a relationship between market structure, conduct, and performance? The hedonic price model for DAP and urea presented in the previous chapter demonstrated that markets that were relatively more competitive had lower prices. Credit prices that were determined in a market held by a government-appointed supplier rather than through a fertilizer auction were up to 10 Birr/quintal higher for DAP and up to 21 Birr/quintal higher for urea relative to the winning bid prices (Table 7.12). This indicates, and as will be determined in the next chapter, that profitability of fertilizer may increase if more competitive influences are promoted in the market. The government has a unique position to design policy that will encourage the development of a low-cost fertilizer market because its policy is critical in shaping who and how many actors are in the market, and hence the outcome of a market. In 1998, as one fertilizer importer/retailer noted, "Fertilizer is a political strategy product--suppliers are not rewarded for being low-cost" (GMRP 1998).

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[78]Government can deny the large wholesalers access to credit, but also to independent retailers–on the grounds that they are not permitted to sell on credit (GMRP 1998).

Table 7.12 Jimma Financial Import Parity Retail Price for DAP Under Increased Competition

Scenario	Assab				Djibouti			
	US$/MT		Birr/quintal		US$/MT		Birr/quintal	
	Low P	High P	Low P	High P	Low P	High P	Low P	High P
<u>Base scenario</u> low- and high-price scenarios	344.44	357.24	237.67	246.50	357.30	370.20	246.54	255.44
<u>Scenario 3</u> Improved competition			227.67	234.50			236.54	245.44

Under-weight Fertilizer Bags. The government-favored companies (Ambassel in Amhara, Dinsho in Oromiya, and Wondo in the South) were accused of under-packing fertilizer bags–at 35-46 kilograms instead of the "standard" 50 kilograms (GMRP 1998). Due to lack of competition in some areas, there was no pressure for the regional government companies to provide a quality product.

In Amhara, Ambassel's careless packaging created a negative externality. Due to their experience with Ambassel, AISE reported that farmers were skeptical whether AISE's bags were the correct weight; therefore, all AISE transactions were weighed--adding a cost to the sale. A quick calculation reveals the magnitude of the problem: at the average retail DAP price of 239.5 Birr/quintal, farmers paid 2.39 Birr/kg. If bags actually weighed 40 kilogram instead of the "standard" 50 kilogram, farmers paid 2.99 Birr/kg, 0.60 Birr/kg more. Thus farmers paid nearly 25 percent more per kilogram due to under-weight bags. This translates into an increase in the price per quintal from 239 Birr/quintal to 299 Birr/quintal, a difference of 60 Birr/quintal.

Delayed Fertilizer Deliveries. Another concern relating to credit administration is that fertilizer delivery was often delayed due to logjams in getting credit organized.

Fertilizer cannot be delivered until past loans are paid and a down payment is made. However, the FDRE has a history of poor credit enforcement, thus in the late 1980s and early 1990s farmers got into the habit of getting fertilizer credit without settling their previous debt, thus also increasing bank debt. In the mid- to late-1990s the FDRE absolved the banks of their debt and took over control of credit by guaranteeing bank loans. In doing so, it also toughened its collection method. However, when in 1998 the SCs were told by the Oromiya Government to put pressure on farmers to repay loans and to screen out defaulters, the request of new fertilizer loans, and hence its arrival, was delayed.

The SCs or the DAs are responsible for collecting the total fertilizer payment. Ministry of Agriculture officials reported that fertilizer debts are to be repaid during harvest (November-January) when farmers have cash; however, in practice loan collection can occur anytime from April, during the *belg* season, to well into the planting time for the second crop, the *meher*, in June and July. It is theorized that farmers in Oromiya are known to delay payment of their previous loans in hopes that when planting time comes for the next season the government will forgive past loans.[79] In a sense, farmers attempted to hold the regional government hostage, knowing they cultivate the most productive land in the country. However, sometimes the plan backfired: in Wonchi, Oromiya Region, farmers were still waiting for fertilizer in late July 1998, months after maize planting (the most responsive crop to fertilizer), but in time for August tef planting (GMRP 1998).

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[79]There was anecdotal evidence that farmers would encourage each other to delay payment–threatening that they would not attend the funeral of those that paid (GMRP 1998).

Another source of delay is that the farmers are often reluctant to pay--not only past loans, but the required down payment. For example, in West Shewa, Oromiya Region, the government is known to change its policy regarding the amount of down payment required. One Service Cooperative official explained, "Because such relaxation is becoming a tradition in the government, farmers purposely wait up until June until the down-payment is zero" (GMRP 1998). The regional government, knowing that planting time was fast approaching, gave 100 percent credit in a last minute decision to get fertilizer delivered close to the time of planting.

Once distribution is approved for credit sales there may be supplier inefficiencies that also result in delay. One reason for the delay is that the supplier may not have the stock available that was agreed in the government contract (e.g., Ambassel did not have sufficient urea available). Another reason for the delay is that often by the time credit is organized, the rainy season has descended, and sometimes distributors refuse to deliver because their contract price did not account for the added transport cost (GMRP 1998). Yet another reason is that the distributor may have insufficient sales clerks. In Amhara, Ambassel only had one sales person to open multiple warehouses in a zone (GMRP 1998).

Delayed deliveries can mean that transport coincides with the annual highs in transport rates. High transport costs and lack of transport remain a primary reason for low productivity, lack of trade, and meager incomes. Productivity gains can be achieved by reducing transaction costs, allowing greater specialization and exchange (Sadoulet and de Janvry 1995). In Ethiopia, an estimated 75 percent of all farms are more than 5 km from the nearest all-weather road (KUAWAB 1995), thus farmers already face high transport costs to the main markets, minimizing transport rates to maize producing areas will help reduce the overall cost of distributing fertilizer to the farm.

High Transport Costs. Due to the rigidity of the timing of the credit programs, fertilizer delivery is delayed and distributors are often forced to transport fertilizer into rural areas during the higher-costs months of the year. Not only are roads scarce in Ethiopia, but the combination of poor roads and a dated and small trucking fleet translates into high transport rates across Ethiopia. The effect of a thin and deteriorated trucking fleet actually accelerated road damage because trucks were heavily overloaded (IFDC 1993). Although axle load regulation was passed in September 1990, it has not been enforced. In 1993, on the main routes to the port, over 60 percent of the trucks checked were over the recommended 10 tons (IFDC 1993).

The transport cost of fertilizer from the ports to Nazreth can add up to an average of 12.5 percent of the ex-Nazreth wholesale price. The additional costs of transporting fertilizer from Nazreth to retail markets is equally significant and as variable. Transport rates are sensitive to the month of delivery and quality of road. One importer/retailer reported that transport rates can increase from around 0.039 Birr/quintal/km on the Djibouti-Nazreth road (827 km) to 0.068-0.090 Birr/quintal/km in June and July for distances up to 400 kilometers from Nazreth, depending upon the nature of the road (GMRP 1998).

A reduction in transport costs will shift out the supply curve and reduce the cost of delivering a given quantity of fertilizer. Empirical evidence abounds that roads have a significantly positive effect on farm productivity--on input use, particularly fertilizer

(Ahmed and Donovan 1992). However, short of investing in building roads and in the quality and quantity of the trucking fleet, it is hypothesized that transport costs can be reduced by taking advantage of the seasonality in freight rates. Transport costs from the ports of Assab and Djibouti to Nazreth account for up to an average of 12.5 percent of the ex-Nazreth wholesale price.

When a shipment arrives at the port, the cargo owner will negotiate transport costs with several transporters to handle a shipment of 25,000 MT. Freight rates, in general, are a function of the distance traveled (the farther the distance, the lower the rate), type of road, and the availability of back-haul. Due to the rigidity of the timing of allocation of foreign exchange, fertilizer imports often coincide with food aid imports in May and June which increases the demand for trucks, thereby increasing freight rates. An improved timing schedule would require an importer transport fertilizer inland during March and April to take advantage of the seasonal lows in freight rates (this assumes costs of all other activities are held constant).

A calculation of a seasonal index[80] assists in determining when freight rates are at their seasonal low (Table 7.13). The seasonal index of freight rates on the Assab-Addis route exhibited a bimodal pattern that is easily explained by trade patterns in Ethiopia (Figure 7.3).[81] For example, the high-priced months of May-August correspond to a period of food aid imports. Freight rates peak again in December and January, but by a

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[80]Ferris, J. 1998.

[81]The use of Djibouti as a port of import is a relatively new practice since the conflict with Eritrea, therefore, there is no freight rate data available.

lower magnitude, due to the harvest season. Trucks are in demand to transport grain from rural areas to Addis as well as between regions and thus there is a scarcity of trucks on the Assab-Addis route. From the seasonal index computed for 1994-1997 it is observed that freight rates of private transporters increased by 22 percent between March and August. The range in the seasonal index was lower for the public transports, a 13 percent price difference between the low in March and the high in July.

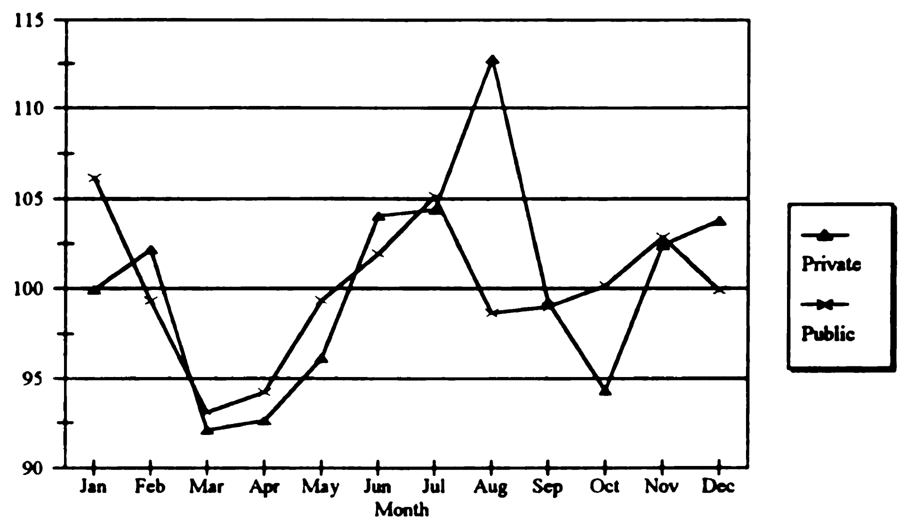
Table 7.13 Assab-Addis Ababa Freight Rates, 1994-1997

	Private Truck-Trailer		Public Truck-Trailer	
	Mean Real Price	Mean Seasonal Index	Mean Real Price	Mean Seasonal Index
	cents/ton/km[1]	%	cents/ton/km	%
January	3.24	99.96	3.32	106.14
February	3.25	102.18	3.13	99.31
March	2.97	92.12	2.96	93.10
April	2.98	92.64	2.98	94.22
May	3.06	96.16	3.14	99.34
June	3.32	104.04	3.20	101.92
July	3.32	104.35	3.28	105.15
August	3.46	112.80	3.07	98.64
September	3.15	99.27	3.04	98.98
October	3.00	94.33	3.11	100.15
November	3.21	102.41	3.12	102.85
December	3.21	103.77	3.04	99.89

Source: Compiled from MEDAC 1999.
Note: [1]Multiply cents by 0.01 to get the Birr equivalent.

Capturing periods of low transport rates on the Nazreth-retail market routes is also a concern. Delayed transport from Nazreth to retail markets (in part due to lengthy credit processing) can mean fertilizer is transported during the higher-cost rainy season. For example, during the rainy season of May thru July, transport costs can more than double

Figure 7.3 Seasonal Freight Rate Index, Assab-Addis Ababa, 1994-97



Source: Compiled from MEDAC 1999.

(0.056 Birr/quintal/km to 0.13 Birr/quintal/km) on the Addis Ababa-Woliso route (124 km, half-way to Jimma from Addis) (GMRP 1998). Due to the seasonality in rains, the seasonal freight rate index for the Addis-Jimma route reveals high-priced months in May-July for public transporters (Table 7.15). Surprisingly, the same trend is not visible for the private truckers, although the seasonal high in October can be explained by the beginning of the *meher* harvest. Although anecdotal evidence revealed that the seasonality in transport rates is larger than that recorded for 1993-1997, the conservative estimate will be used in simulating a reduced Jimma retail price. It is estimated that if fertilizer could be delivered from Nazreth to Jimma in February-March, rather than April-May, the transport rate could be reduced by 5 percent (0.16 cents/quintal/km--an average of the difference between the two sets of months and for both public and private truckers (calculated from Table 7.14)).

Table 7.14 Addis-Jimma Freight Rates, 1993-1997

	Private Truck		Public Truck	
	Mean Real Price	Mean Seasonal Index	Mean Real Price	Mean Seasonal Index
	Ethiopian cents/ton/km[1]	%	Ethiopian cents/ton/km	%
January	3.68	99.54	3.62	94.26
February	3.77	101.48	3.82	97.98
March	3.61	97.51	3.84	98.75
April	3.97	108.07	4.15	106.80
May	3.64	99.13	3.93	101.69
June	3.58	97.86	3.89	101.35
July	3.62	99.43	4.07	106.77
August	3.52	97.89	3.76	98.91
September	3.49	97.16	3.57	93.52
October	3.73	106.23	3.54	92.64
November	3.53	98.40	3.56	99.25
December	3.56	99.74	3.91	109.26

Source: Compiled by MEDAC 1998.
Note: [1]Multiply cents by 0.01 to get the Birr equivalent.

Several scenarios are estimated to calculate the potential price reduction from reductions in transport costs (Table 7.15). In scenario 4 transport rates from the port to Nazreth are reduced by 12 percent (equivalent to the mean spread in prices between March and July, 1994-97) and transport rates from Nazreth to Jimma are reduced by 5 percent.

In scenario 5 transport rates on the two segments of the trip to Jimma will be reduced (as in scenario 4), but an additional assumption is that 100 percent of the fertilizer is delivered from the port inland (none stored in the port, which is only applicable in

Table 7.15 Jimma Import Parity Retail Price for DAP Under Estimated Transport Rate Reductions

Scenario	Assab				Djibouti			
	US$/MT		Birr/quintal		US$/MT		Birr/quintal	
	Low P	High P	Low P	High P	Low P	High P	Low P	High P
Base scenario low- and high-price scenarios	344.44	357.24	237.67	246.50	357.30	370.20	246.54	255.44
Scenario 4 12% Reduction in Port-Nazreth Transport Rate and 5% Reduction in Nazreth-Jimma Transport Rate	335.85	348.65	231.74	240.57	347.62	360.52	239.86	248.76
Scenario 5 Scenario 4 plus 100% Direct Delivery[2]	333.66	346.46	230.22	239.05	342.19	355.08	236.11	245.01
Scenario 6 Scenario 5 plus 10% Reduction in Low-priced F.O.B. (Reduced supplier uncertainty/improved timing)	321.72	346.46	221.99	239.05	330.26	355.08	227.88	245.01

Notes: [1]Assumes the Djibouti-Nazreth freight rates is 0.0456 US$/MT/km instead of 0.057 US$/MT/km and the Assab-Nazreth rate is reduced to US$/MT/km 0.035 from US/MT/km 0.44.
[2]Savings from direct delivery only applicable in Djibouti.

Djibouti). It is feasible that reduced transport rates (i.e., ample supply of trucks) will accompany reduced port storage in Djibouti because port storage occurs when there are insufficient trucks to transport the fertilizer inland. In Djibouti roughly 25 percent of a ship's cargo will be stored at the port for lack of transport. Assuming a shipment of 25,000 MT of DAP is imported, a Transit Charge of US$ 7.20/ton is paid on the portion stored in addition to US$ 1.50/ton charged on the entire shipment--thus summing to US$ 3.30/ton. If zero fertilizer is stored at the port this charge drops to US$ 1.50/MT. The net savings on a 25,000 MT shipment is US$ 45,000 (equal US$ 1.80/MT savings).

By reducing transport rates alone, on both legs of the route to Jimma, the Jimma import parity price can be reduced by 7 Birr/quintal from an average of 246 Birr/quintal for DAP (calculated from Table 7.15). Calculating in the additional likelihood that port storage could be avoided with increased supply of trucks, the Jimma price is reduced by a total of 9 Birr/quintal (4 percent of the base case). The additional assumption of a 10 percent reduction in the obtained f.o.b. price drops the Jimma retail price to 228 Birr/quintal, 7.6 percent of the base case.

Policy Uncertainty. Due to the fact that farmers prefer to purchase inputs on credit and that government credit removes the risk of marketing, fertilizer distributors preferred to rely upon the organization of credit for their sales (GMRP 1998). In effect, the organization of credit in 1998 was uncertain, and also tardy. For example, many more zonal governments announced plans to hold fertilizer auctions than were actually realized (GMRP 1998). In other cases, supposed tacit contracts with regional governments were broken. Overall, a common problem in 1998 was that markets were unexpectedly closed to integrated retailers and independent retailers due to unpredictable government policy.

Policy uncertainty can add considerable costs (in terms of delays and lost markets) to doing business, thus serving as a disincentive for private retailers to enter the inputs market. Because distances are great, there is seasonality in transport rates, and because fertilizer demand is seasonal, securing a market early in the season is critical for distributors to remain competitive. If a potential market is unexpectedly closed at the beginning of a season, the probability of finding a new market is low.

In 1998 stated fertilizer polices to liberalize markets were often abandoned,[82] thus markets were not as "free" as the fertilizer distributors originally perceived. Although regional governments announced that fertilizer auctions were to be held in many areas, there was uncertainty as to when and whether regions would actually hold the auctions. In the Oromiya Region, auctions were held, but they were late, leaving the distributors to ponder whether to redirect their fertilizer stock. One company reported that they had sent an employee, armed with the cash bid bond, to a wereda capital[83] to submit a bid for an auction. However, when the employee arrived in town, he faced a delay of up to week, raising the cost of participating in the government's auction (GMRP 1998). In the Southern Region, only nominal auctions were held, at the end of the fertilizer season in August. When auctions were indeed held, it was not uncommon for the FDRE to unexpectedly inform some integrated retailers, and all smaller independent retailers, that they could not participate in the auctions.

Even in regions where fertilizer auctions were not as common, government policy was uncertain. EAL incorrectly assumed it could distribute the stock it held in the Amhara Region and was surprised to find it was denied distribution rights at the beginning of the season. Only when it became evident that Ambassel (the government-nominated supplier) was running short of urea, a contract was awarded to EAL for 30,000 quintals. However, after the government paid for 50 percent of the contract and took delivery of the paid

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[82]Fertilizer prices were liberalized, but government control of credit and favoritism in distribution meant that competition was severely constrained.

[83]There was no choice but to deliver the cash bid bond in person in the designated point of registration, the wereda capital.

portion, it canceled the remaining order, leaving EAL feeling "tricked" (GMRP 1998). EAL had the stock ready for delivery and found, after the contract was broken, that it was too late to position stocks elsewhere.

If fertilizer distribution policies were more transparent then it may be possible to reduce costs in the system. For example, if it was possible to increase the direct delivery from the port to the point of retail (if a distributor was certain he/she could secure a market), then storage and handling costs, as well as interest could be saved. Currently, most fertilizer is stored in Nazreth for up to two months, waiting for government distribution policies to be set, before it is sent on to retail markets.

The cost savings from bypassing unloading, storage,[84] and interest for two months in Nazreth is 4.10 Birr/quintal which is relatively small compared to the transport cost savings that would be achieved in this scenario. If the fertilizer can be shipped directly from the port to Jimma it is possible to obtain, at a minimum, the lower port-Nazreth rate for the entire port-Jimma trip.[85] The total cost of transport from the ports to Jimma after 2 months in Nazreth is 44.22 Birr/quintal from Assab and 52.95 Birr/quintal from Djibouti. If fertilizer is transported directly from the port to Jimma at the freight rate offered for the port-Nazreth route, and 100 percent of fertilizer was directly delivered

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[84]Storage costs in most outlying areas (e.g., Jimma at 0.25 Birr/quintal/month) were lower in 1998 than the cost of storage in Nazreth (0.35 Birr/quintal/month).

[85]The cost of transport from Assab to Nazreth is 23.80 Birr/quintal and 32.53 Birr/quintal from Djibouti to Nazreth and the cost from Nazreth to Jimma is 20.42 Birr/quintal. Given that rates are reduced for longer distances, and the road from Nazreth to Jimma is relatively good, it may even be possible to negotiate a lower rate than currently received for the port-Nazreth route.

(none left in storage at the port), the total cost of the trip is 37.28 Birr/quintal from Assab and 49.99 Birr/quintal from Djibouti (cost savings of 6.94 Birr/quintal and 2.96 Birr/quintal, respectively). Under these assumptions, Jimma retail prices can be reduced by up to 13 Birr/quintal (roughly 3.5 percent of the 1998 mean Jimma DAP retail price) (Table 7.16).

Table 7.16 Jimma Import Parity Retail Price for DAP Under Reduced Policy Uncertainty (Direct Delivery from Port to Retail Markets)

Scenario	Assab				Djibouti			
	US$/MT		Birr/quintal		US$/MT		Birr/quintal	
	Low P	High P	Low P	High P	Low P	High P	Low P	High P
Base scenario: low- and high-price scenarios	344.44	357.24	237.67	246.50	357.30	370.20	246.54	255.44
Scenario 7 Direct delivery from port to retail market	327.71	340.29	226.13	234.81	344.54	357.22	237.74	246.49
Scenario 8 Scenario 7 + low-priced f.o.b. reduced by 10% (improved timing/reduced uncertainty)	304.23	340.29	209.93	234.81	321.07	357.22	221.55	246.49

If it is additionally assumed that fertilizer importers could obtain a 10 percent lower price on the international markets (perhaps from increased certainty of delivery date or from purchasing fertilizer during the low-priced months) then the Jimma retail price could be reduced by 10 percent from the base case scenario (Table 7.16).

7.5.1 Open Market (Cash Market)

The administration of government credit has direct implications for the structure and consequent underdevelopment of the cash market.[86] In many areas of the country, there was an unmet demand for fertilizer credit that was not being adequately met by the cash market, either because cash sales were unavailable or the cash price of fertilizer rendered fertilizer unprofitable (GMRP 1998).

The combination of the active promotion of the NEP, the high demand for credit, and the high degree of government-encouraged vertical integration resulted in a particularly thin cash market in 1998.[87] Some local governments actively discouraged the development of a retail network for cash sales because of the perception that potential clients of cash sales would primarily be those having defaulted on past credit loans and therefore should be punished (GMRP 1998). Another explanation is that if farmers had alternate sources of fertilizer they would not sign up for the NEP and program targets would not be met. In the Southern Zone of Kembata one independent retailer selling only on cash complained bitterly that it was more difficult to enter the fertilizer business that year because the government prohibited retailers from operating in order to ensure that the NEP expanded (GMRP 1998). Independent retailers in other Southern zones stated that farmers were intimidated by local government officials: they were told they could not

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[86]As mentioned in chapter 3, the amount of fertilizer sold on cash varies considerably across regions and even between neighboring zones within a region.

[87]This was also reported by Demeke et al. in 1997, a year earlier than this review.

purchase fertilizer from the independent retailers, so they only bought on credit from Wondo (GMRP 1998).

The government also discouraged the development of cash sales by placing restrictions on pricing behavior of cash retailers. An independent retailer in the South explained that his store was closed by other distributors that have "political backing"[88] because he offered a lower cash price than the credit price (GMRP 1998). He was informed that he could operate as long as his price equaled that of Wondo, the government-appointed distributor.

The high demand for credit is one key reason why cash sales were low in 1998; however, it is not necessarily a signal that farmers could not purchase fertilizer without credit. One independent retailer in West Shewa, Oromiya said, "Availability of credit for farmers is the major problem, because farmers want to get fertilizer on a credit basis even if they have the ability to purchase on cash basis. This hinders retailers to activate cash sales" (GMRP 1998). Indeed there are many extremely poor farmers that require credit; however, it is hypothesized that in 1998 there were pockets of excess demand for fertilizer that could have been fulfilled by the cash market. An independent retailer in Sendefa, North West Shewa, Oromiya, noted that, "Some farmers sell livestock in order to increase their fertilizer cash purchasing power" (GMRP 1998).

Overall, in most areas of the country, the NEP and SC credit programs and the cash market did not operate simultaneously. The cash market proved to be robust in cases

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[88]Previous actions, such as denying rival companies access to credit, revealed that the regional government supported this companies' position in the market.

where the NEP was not present or was unable to fulfill the demand for fertilizer. There were cases where the "inability of farmers to repay last year's credit made independent retailers to enter without competition because the large wholesalers/retailers were not there" (GMRP 1998). As seen from the estimates of the hedonic fertilizer price model (chapter 5), cash prices were higher than credit prices when a fertilizer auction was held; however, cash prices were lower than credit prices if a mandated market was present. It is possible that the cash market can be a low-cost option for farmers that do not have access to the NEP, and it is certainly a lower-cost option than the monopoly markets that provided limited high-cost fertilizer to the select NEP farmers.

Although the NEP has been expanding rapidly (reaching a goal of nearly 7 percent of the rural population in 1999), it can not serve all farmers, and therefore adoption of new technologies will require that credit is available outside the NEP and that the cash market is sufficiently developed (i.e., that the cash market exists and farmers find the price profitable). Several independent retailers and also officials of Service Cooperatives suggested that the government provide credit for poor farmers and encourage the rich farmers to purchase on cash (GMRP 1998). One SC official reported, "Credit for fertilizer is becoming a culture, any farmer, even those that can buy fertilizer on cash, wants credit" (GMRP 1998). This independent retailer said he plans to "agitate the government not to give credit to resource rich farmers" (GMRP 1998).

Overall, independent retailers were fully aware of the heavy involvement of the government in the fertilizer sector to the detriment of their business. An independent retailer in Hadiya, Souther Region noted, "Political organizations shouldn't participate in fertilizer trading. It should be left to individual businessmen" (GMRP 1998).

7.6 Extension

The NEP has exhibited phenomenal short-run success in rapidly expanding the program to a broad base of farmers. However, the rapidly expanding program is already experiencing some difficulties in delivering a timely and quality input/extension package because input and credit markets are not evolving as rapidly and efficiently as needed and extension services are being forced to fill in the gaps rather than focus exclusively on the extension mission.

Analysis of the SG 1997 survey data confirms that farmers must learn appropriate management practices if they are to get the full benefits from improved technologies. Yield determinant models showed that for each week of deviation from ideal planting dates, yields declined by 194 kg/ha (p=0.03) (Howard et al. 1999). In addition, the yield model presented in the previous chapter revealed that there are important complementarities between timing of weeding and seeding density. Thus, there are concerns that the momentum of the NEP program may be suppressed by the (1) diluted quality of extension advice due to increased demands on time of existing personnel, and (2) inefficiencies in the administration of the credit program.

There is evidence that DAs (extension agents) may become overextended with the rapid expansion of the NEP and thus compromise the quality of the extension service. Given that the broader population served by the NEP will need more, rather than less supervision due to lower literacy rates (25 percent literacy for household heads nationally versus 90 percent for SG participants), the substantial increase in plots per agent is worrisome. SG agents in 1997 covered 60-70 plots; however, in 1998 NEP case loads ranged from 150-500 plots (the recommended level is 100 (Abate 1997)). Survey data for 1997 showed that SG agents made an average of 12 visits per farmer which is no longer possible with greater than 150 plots per agent.

The second extension problem is that the NEP attempts to serve as a surrogate for well-functioning fertilizer and seed markets[89] by providing administrative support[90] to banks and fertilizer distributors (processing credit applications, collecting reimbursements, and transporting fertilizer) without due compensation. The Ministry of Agriculture is paying the salaries of the DAs, supervisors, as well as administrators in the Wereda Bureaus of Agriculture to provide services that could be provided by the private sector. District agricultural officers and extension agents interviewed in 1998 reported insufficient time to perform their normal duties due to these additional tasks and noted that their role in collecting credit repayments created an undesirable adversarial relationship between farmers and themselves.

As shown in the last section, in some cases the credit workload is so heavy that it leads to delays in fertilizer distribution (due both to delayed repayment of prior credit and slow processing of current loans). In 1998 all Service Cooperatives and Agricultural

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[89]Hybrid maize seed is not commonly available on the open market, only through the NEP.

[90]The 1998 Input Subsector Survey revealed that instead of "support", the NEP may be imposing costs on banks, regional government administration, and government extension services.

Bureaus interviewed reported late deliveries due primarily to delays in credit reimbursement and credit processing, with some cases of supplier inefficiencies which required government personnel to provide substitute services. For example, government personnel and vehicles were used when one supplier failed to fulfill their NEP contract due to lack of transport and storage. The Agricultural Bureau was forced to incur the costs of transport to the outlying distribution centers without due compensation. Thus, the NEP may not be financially sustainable in the long-term because too many non-extension tasks are being imposed on extension agents.

The overall impact of increased plots per agent and extra tasks is a lower quality extension message with increased (non-extension) costs attributed to the extension program. Thus, the NEP may have to cut back, rather than expand, its coverage. Ensuring sustainable adoption of the improved technology is in part predicated upon the sustainability of the NEP to deliver a high quality extension message.

7.7 Conclusion

This chapter revealed that there were warning signs in the 1998 inputs markets that farmers may not be receiving the necessary low-cost fertilizer, access to credit, and quality extension required to ensure long-term adoption of high-input technologies. The FDRE's actions in the inputs market are not characteristic of a government striving to promote a competitive, low-cost input market. It was observed that in 1998 the FDRE used access to input credit to promote selected companies in the market, actively discouraged the development of a cash market for fertilizer, crowded out other private fertilizer distributors from the market, and may have overextended its extension program. This chapter provided qualitative and quantitative evidence that the fertilizer subsector was not providing a fertilizer product to farmers at least cost nor providing an attractive environment for private sector investment.

It is shown that, with government support, Ethiopia can realize savings from the reorganization and improved coordination of the process of import and distribution. National and regional governments' heavy hand in all stages of the subsector prevented a lower-cost system by constraining entrepreneurial innovation which stems from competition. Costs can be reduced, for example, if the private sector has the ability to determine the timing of its activities (e.g., to take advantage of season lows in prices.). The point of this chapter was not to determine an optimal timing scenario that could reduce fertilizer costs to the farmer, but to show that with increased private sector autonomy and improved coordination among actors in the system costs could be reduced. The identified cost reductions in this chapter will be summarized in the following chapter and used in a simulation exercise to determine the extent to which fertilizer profitability can be increased.

CHAPTER 8

IMPROVING THE PROFITABILITY OF HIGH-INPUT MAIZE TECHNOLOGY IN ETHIOPIA

In Jimma Zone in 1997 the cost of fertilizer was 34 percent of the total variable cost of investing in the SG high-input technology--improved seed equaled 8.5 percent, labor was 45 percent, animal traction, 8 percent, and hand tools and sacks was 5 percent (compiled from Howard et al. 1999). At this magnitude, the cost of fertilizer can determine whether adopting high-input technology is a viable option for increased maize productivity growth in Ethiopia, especially as the input package is expanded to farmers that are less well-off or less educated than the SG participants or to farmers in less favorable agro-ecological areas. This chapter addresses the questions: (1) How profitable is fertilizer use and the SG package, specifically, given variations in yields within each technology level–that is, what is the production risk associated with the new technology; (2) Does the net benefit of the high-input technology exceed the cost, given the high-input technology requires additional labor; and (3) To what extent could the proposed cost reductions (from chapter 7) in the fertilizer subsector effect the profitability of the new technology?

8.1 Measuring Profitability

Two techniques are used to capture the attractiveness of investing in new technologies by farmers: a partial budget and a marginal analysis. The partial budget approach is used to evaluate changes in profitability from changes in fertilizer prices by calculating net income and returns to labor. Partial budgets indicate the net gain attributable to switching from current practices to recommended practices. Partial budgeting "was developed to calculate the total costs that vary and the net benefits for each treatment of an experiment" (CIMMYT 1998:9). The term "partial" indicates that only costs are included that are affected by alternative technology packages--costs that change over and above the control practice: local seed and roughly 100 kg/ha DAP.

A marginal analysis captures whether the increase in net income exceeds the incremental costs when moving from one technology combination to a more costly one. Higher benefits will not attract investment if accompanied by even higher costs. A marginal rate of return (MRR) was calculated--the marginal net benefit (i.e., the change in net income) divided by the marginal cost (i.e., the change in variable costs)--to determine the increased net income from a unit of investment (CIMMYT 1998). It is assumed that the objective of the farmer is to invest in a new technology if and only if the expected return is equal or greater than the return in alternative investments; however, such data is not usually available. A limitation to the partial and marginal analyses is that even when fertilizer is absolutely profitable, there is evidence that farmers still do not use fertilizer (Yanggen et al. 1998). A possible explanation is that absolute profitability is a necessary but not a sufficient condition for fertilizer adoption (Yanggen et al. 1998). Fertilizer must be profitable, but it also must be more profitable than competing investments.[91]

The rule of thumb used in this analysis for determining whether a farmer should invest in a new technology is that the new technology (e.g., improved seed or fertilizer) must produce a minimum of a 100 percent marginal rate of return (CIMMYT 1998). However, if the technology is an adjustment in a current practice (e.g., increasing the fertilizer rate), then a 50 percent rate of return may be appropriate (CIMMYT 1998).[92]

8.2 Financial Analyses

This chapter examines the robustness of the profitability (i.e., net incomes, returns to labor, and MRR) of improved maize technologies under different fertilizer prices. Proposed areas for cost reductions in the fertilizer subsector, delineated in the last chapter, were used to simulate changes in profitability of using the high-input technology.

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[91]As an example, evidence exists that in Jimma Zone in 1992 the profitability of maize was 774 Birr/ha compared to 419 Birr/ha for coffee; and the return to maize per workday was 6.65 Birr and 2.35 Birr for coffee (Seyoum and Regassa 1992).

[92]An alternative approach to calculating the target MRR is to take the actual interest rate on a formal loan (10.5 percent in Ethiopia in 1998) and add 20 percent for a risk premium (Perrin et al. 1979 in Crawford and Kamuanga 1988). In Ethiopia it was found that farmers were using fertilizer at a return of 41 percent, higher than the 30.5 percent recommended rate that this approach gives (Demeke et al. 1998).

8.2.1 Method

Farm budgets from a *recommendation domain*[93] of three weredas--Kersa, Seka-Chekorsa, and Dedo--surrounding Jimma town in Jimma Zone, Oromiya Region, were the focus of this analysis. These areas share similar agro-ecological characteristics–all have predominately red soil and similar rainfall patterns–and all considered high-potential maize areas.[94]

The financial import parity price in Jimma town in the last chapter was recalculated for the SG participating weredas: Seka Chekorsa, Kersa, and Dedo. The average additional distance of these three weredas from the zonal capital is 21 km. Thus transport, loading and off-loading costs were added onto the Jimma financial import parity price calculation presented in the last chapter.

Chapter 7 outlined possible areas for cost reduction in the fertilizer subsector from liberalization of the rigid timing structure imposed on fertilizer importers and distributors. The base scenario for fertilizer prices was the financial import parity price for low and high-priced f.o.b. scenarios, calculated from a detailed cost build-up presented in Tables 7.1 and 7.2. The maximum prices could reasonably be expected to decline with these specified cost reductions is 10.9 percent for DAP and 9.4 percent for urea (Table 8.1).

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[93]A group of farmers whose agro-ecological environment is sufficiently similar to warrant the same technology recommendation.

[94]Of the three weredas, Dedo receives the lowest average annual rainfall (900-1400 mm), Kersa receives roughly 1410 mm, and Seka-Chekorsa receives between 1400-1600 mm (Buta 1997). Average rainfall is lower than other maize producing regions, Ilubabor, south-west of Jimma, and East Wolega, north-west of Addis Ababa.

Table 8.1 Summary of Potential Cost Reductions in the SG-participating[1] Wereda Retail Prices of DAP and Urea, Birr/quintal, F.O.B. Djibouti

Scenario	Description	Assumed Cost Reduction	DAP[2]	Urea
			(percentage change from base case in parentheses)	
Base case	Financial Import Parity Price		248.80	163.47
1	Reduced shipment date uncertainty	5% reduction in low-case (from tables 7.1 and 7.2) f.o.b. price	240.60 (3.29)	161.47 (1.23)
2	Scenario 1 plus Improved Timing	10% reduction in f.o.b. price (various origin)	232.37 (6.60)	157.55 (3.62)
3	Improved competition (results from hedonic price model)	DAP price falls by and urea price falls by	238.80 (4.02)	142.47 (12.85)
4	Reduced transport costs	12% reduction in port-Nazreth rate and 5% reduction in Nazreth-Jimma rate	239.86 (3.59)	156.80 (4.08)
5	Scenario 4 plus 100% direct delivery (zero fertilizer stored at the port)	Direct delivery reduces the Transit Charge by 54.5%	236.11 (5.10)	155.56 (4.83)
6	Scenario 5 plus reduced shipment date uncertainty	10% reduction in f.o.b. price (various origins)	227.88 (8.40)	147.38 (9.84)
7	Reduced marketing uncertainty, direct delivery from port to retail market	Bypass unloading and storage in Nazreth. Direct delivery reduces the Transit Charge by 54.5%	237.74 (4.44)	156.07 (4.52)
8	Scenario 7 plus reduced shipment date uncertainty	Low-priced f.o.b. reduced by 10%	221.55 (10.95)	148.03 (9.44)

Source: GMRP, Input Subsector Survey 1998.
Note: [1]Recorded for the same weredas in Jimma as the SG survey: Dedo, Kersa, and Seka Chekorsa, n=20 for DAP and n=9 for urea.
[2]The low price scenario will be used in the budgets as representative of the maximum price reduction possible under improved coordination in the fertilizer market.

Three scenarios will be used in a sensitivity analysis of farm profitability of the high-input technology: scenarios 3, 6, and 8 (all scenarios are reviewed in table 8.1). *Scenario 3* represented results from the hedonic fertilizer price model in chapter 5. It shows that increased competition whereby credit prices that were determined in a market held by a government-appointed supplier rather than through a fertilizer auction were up to 10 Birr/quintal higher for DAP and up to 21 Birr/quintal higher for urea relative to the winning bid prices. However, Jimma Zone was a relatively competitive market, thus the simulation analysis will show by how much profitability would decline if the fertilizer market had been appointed by the regional government and fertilizer auctions were not held.

Scenario 6 was a reduction in transport rates on both the port-Nazreth route as well as on the Nazreth-Jimma route (12 percent reduction in port-Nazreth freight rate and 5 percent reduction on the route from Nazreth to Jimma) as well as an assumption of 100 percent direct delivery (no fertilizer stored at the port). *Scenario 6* also assumed that international f.o.b. prices in Jordan for DAP could be reduced due to increased certainty by international suppliers of the delivery date.

Scenario 8 assumed that due to a reduction in policy uncertainty (e.g., whether and when fertilizer auctions were held) direct delivery from the port to a retail market such as Jimma would be possible, bypassing 2 months of storage in Nazreth and reducing port storage. *Scenario 8* also assumed a 10 percent reduction in the f.o.b. prices obtained by Ethiopia in 1998 from various international markets.

Four levels of technology were evaluated in the financial analysis (as defined in chapter 6)--two under the SG package and two using traditional technologies. Technology types 1 and 2 represented non-SG technologies: technology type 1 used neither fertilizer nor improved seed, and type 2 used local seed and roughly 100 kg/ha DAP. Technology types 3 and 4 represent farmers that were either current or past participants of the SG program. Technology type 3[95] used improved seed, 86 kg/ha DAP, and 86 kg/ha urea (less than the recommended 100 kg/ha of each), and technology type (4) used improved seed, 116 kg/ha DAP, and 116 kg/ha urea. Many of the SG graduates in 1997 participated in the NEP which followed basically the same recommendations as the SG.

A return is calculated from the product of the adjusted yield and the farmgate price of maize. Yield is adjusted downward to capture the loss in grain from storage from when maize is harvested in November and crop sale in January (storage losses of 1.98 percent per month). The farmgate price used in the analysis is recorded in January, immediately following harvest, when a large portion of households sell a large portion of their harvest.[96] All prices are recorded as financial market prices (as opposed to shadow prices in an economic analysis).

Two measures of return are calculated: net margin per hectare and gross margin per hectare. Net margin is the return (value of output) minus variable costs--package costs (improved seed, DAP, urea, herbicide, insecticide, and fungicide), labor costs, cost of animal traction, and cost of hand tools and sacks. For net margin, the family and mutual[97] labor was valued at its opportunity costs–the daily wage rate (3-6 Birr/ha,

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[95]Technology 3 consists of 61 percent of the graduate sample and 49 percent of the SG sample.

[96]In Ethiopia, on average 18 percent of crop sales are made in January, 17 percent in February, 16 percent in March, 16 percent in April, 13 percent in May (CSA 1995/96).

[97]Mutual labor refers to labor provided by extended family and friends free of charge (for neither cash nor in-kind payment).

average 4.5 Birr/ha). For the second measure, gross margin, the cost of family and mutual labor was not counted. The returns to family and mutual labor was calculated by dividing net income per hectare by the number of family and mutual labor days.

The classic approach is to value labor by its opportunity cost--"the wage which could be earned in off-farm employment, or the value of the time spent on another farm enterprise, or the value which the worker places on leisure" (Perrin et al. 1979 in Crawford and Kamuanga 1998). There are limitations to this approach due to several reasons as specified by Crawford and Kamuanga (1998): (1) it is difficult to value leisure, (2) off-farm labor may not be a viable option, and (3) farmers often are willing to work on their farm for less than the off-farm wage. Nonetheless, given that one objective of this analysis is to compare the profitability (MRR) of different technology treatments and given the importance of labor as a cost, the MRR calculations were based on net margin per hectare, which takes into account all labor costs.

In Howard et al. (1999) the high-input technologies were highly profitable for each technology type on average, however, it is questionable whether the profitability of the new technology is robust at all yields levels, given that there is considerable variation in yields within each technology grouping. The standard deviation (SD) of yields for technology type 2 was 1,245 kg/ha (mean 2,905 kg/ha); for technology type 3 the SD was 1,364 kg/ha (mean 5,922 kg/ha); and the SD for technology type 4 was 1,595 kg/ha (mean 5,910 kg/ha). Successful expansion of the high-input technologies is predicated upon the robustness of the 1997 SG Jimma success in the face of less favorable soil and climatic conditions and management practices, and thus, lower-than-average yields.

One method of estimating the risk associated with the high-input technology is to observe the across-location and across-technology yield variability (CIMMYT 1988). This is accomplished by dividing the broad technology groupings into two groups–the 50 percent of farmers with the lowest yields and the 50 percent of farmers with the highest yields. Did farmers that received the lowest yields within each technology group achieve profitability similar to the average profitability? How sensitive is profitability to changes in yields? This issue is particularly important as the high-input technologies are expanded to less favorable agro-ecological areas and to farmers with perhaps lower management skills than the SG participating farmers.

A second level of analysis is to divide the technology groups into halves, not by yield, but by the level of labor use (family, mutual, and hired labor). Defining technology treatments by the level and type of seed, and the level of fertilizer omits a significant cost component of labor. As mentioned at the beginning of the chapter, labor is 45 percent of the cost of the SG technology. On average, technology type 2 used 88 labor days, compared to 102 labor days for technology type 3, and 144 labor days for technology type 4. Is the increase in costs associated with technology type 4 compensated by an increase in net margin? Thus, technology treatments should not only concentrate on the level and type of seed and fertilizer, but whether sufficient labor is available and whether the high-input technology renders the additional labor input profitable.

8.2.2 Results

The purpose of a financial analysis is to assess the attractiveness of an enterprise to farmers (Crawford and Kamuanga 1988). This section will present a partial budget of the high-input SG technology and then calculate the net margin (valuing family/mutual labor at its opportunity cost), gross margin (which does not deduct the cost of family/mutual labor), and the MRR to using the high-input technology from a base case whereby farmers used local seed and no fertilizer.

The total average cost of using the SG high-input technology (technology type 4) increased 11 percent over technology type 2 (no seed, some DAP) (Table 8.2). The combination of fertilizer and seed was 74 percent of the total variable cost of the SG technology package. The cost of hired labor also increased–from 36 Birr/ha in technology 2 to 50 Birr/ha for the SG farmers (technology type 4).

The net margin per hectare almost doubled from the case of local seed/no fertilizer, to partial adoption of the SG package (local seed, but some DAP)–from 246 Birr/ha to an average of 667 Birr/ha. A benefit of the disaggregation by yields, rather than only calculating averages for each technology type, reveals that farmers using local seed and DAP (no urea) in the lower yield grouping (technology 2) received lower net margins and gross margins than if they had continued with the local seed/no fertilizer practice. Thus there is a production risk associated with the adoption of fertilizer.

If, however, a farmer adopted improved seed and used varying levels of both DAP and urea, then gross and net margins for all yield levels far surpassed the returns calculated for the local seed/no fertilizer treatment as well as the local seed/DAP treatment.

Table 8.2 Financial Analysis by Technology Type and Maize Yield

Budget Item	Tech 1 Local seed, no fert T1.0	Technology Type 2 Local seed plus DAP T2.1 lower yield half	T2.2 upper yield half	T2.3 average	Technology Type 3 Imprv seed, DAP,urea< recomm T3.1 lower yield half	T3.2 upper yield half	T3.3 average	Technology Type 4 Imprv seed, DAP,urea>= recomm T4.1 lower yield half	T4.2 upper yield half	T4.3 average
n	4	21	22	43	28	28	56	25	25	50
1. Maize yield (kg ha)	1835.00	1977.89	3789.44	2905.00	4619.05	7060.26	6007.00	4883.00	6960.95	5922.00
1.a. Adjusted maize yield (kg ha)[2]	1763.00	1938.73	3714.41	2847.48	4527.59	6920.47	5888.06	4786.32	6823.12	5804.74
2. Farmgate price of maize (Birr ha)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return (1.a.*2.)	952.02	1046.91	2005.78	1537.64	2444.90	3737.05	3179.55	2584.61	3684.49	3134.56
4. Total Variable Costs (5.+6.+7.+8.+9.)	705.90	827.07	926.83	871.90	1235.18	1461.29	1373.90	1628.55	1767.32	1694.90
5. Total Package Costs (5.a+5.b.+...5.f.)[3]	49.00	296.76	304.09	301.00	534.22	562.93	549.00	738.13	703.18	721.00
5.a. Seed (Birr ha)	49.00	41.17	36.33	39.00	107.60	113.08	111.00	148.67	141.34	145.00
5.b. DAP (Birr ha)	0.00	255.59	266.06	261.00	219.36	230.51	225.00	303.06	288.12	296.00
5.c. Urea (Birr ha)	0.00	0.00	0.00	0.00	206.65	217.16	212.00	285.51	271.43	278.00
5.d. Herbicide (Birr ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	1.00
5.e. Pesticide (Birr ha)	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.00
5.f. Fungicide (Birr ha)	0.00	0.00	1.70	1.00	0.00	2.18	1.00	0.89	1.22	1.00
6. Interest[4]	0.00	0.00	0.00	3.00	11.06	26.23	14.00	9.30	25.62	13.00
7. Labor (7.a. + 7.b.)	387.00	366.87	411.93	454.50	448.11	468.95	596.50	598.05	690.52	779.00
7.a. Family and mutual labor (Birr ha)[5]	351.00	343.26	364.10	418.50	396.18	371.43	517.50	546.08	643.00	729.00
7.a.i. Family and mutual labor days	78.00	76.28	80.91	93.00	88.04	82.54	115.00	121.35	142.89	162.00
7.b. Hired labor (Birr ha)[6]	36.00	23.61	47.83	36.00	51.93	97.52	79.00	51.97	47.52	50.00
8. Animal traction (Birr ha)[7]	261.00	101.11	94.31	98.00	100.30	186.65	144.00	132.98	135.27	134.00
9. Hand tools and sacks (Birr ha) (9.a +9.b.)	8.90	62.33	116.51	15.40	141.49	216.53	70.40	150.09	212.72	47.90
9.a. Tools (Birr ha)[8]	3.10	2.99	2.83	2.90	2.92	4.72	3.80	3.60	3.89	3.70
9.b. Sacks (Birr ha)[9]	5.80	59.34	113.68	12.50	138.57	211.81	66.60	146.49	208.83	44.20
Net Margin/Hectare (3.-4.)	246.12	219.84	1078.95	665.74	1209.72	2275.76	1805.65	956.07	1917.17	1439.66
Gross Margin/Hectare/Labor Day (3.-4.+7.a.) 7.a.i.	7.66	7.38	17.84	11.66	18.24	32.07	20.20	12.38	17.92	13.39

Source: Compiled from Howard et al. 1999.

Notes: Following page.

Notes for Tables 8.2 and 8.3:

[1]Technology types were split into two: the 50% of farmers with the lowest yields and highest yields.
[2]Assumes no grain lost during shelling. Adjusted yield assumes maize harvested in November and storage losses of 1.98% per month until crop sale in January.
[3]MOA/SG2000 maize package consists of 25 kg/ha seed, 100 kg/ha DAP, 100 kg/ha urea.
[4]SG participants pay no interest; MOA program participants pay 10% interest annually for 10 mo.
[5]Mutual labor provided by extended family members. Family/mutual labor valued at an ave. 4.5 Birr/day.
[6]Valued at cash/in-kind payment rates provided by survey participants.
[7]Sum of rental costs reported by survey respondents; and for owned/borrowed oxen, maintenance plus depreciated value of animals and animal traction. Equipment multiplied by percentage of total farm represented by the MOA-SG, traditional or graduate plot.
[8]Depreciated value of 2 hoes, 2 axes, 2 cutting knives.
[9]Depreciated value of sacks needed to transport maize marketed in January. Since sacks are retained by farmers and used for other purposes, cost is apportioned by multiplying depreciated sack value by percentage of total farm represented by MOA-SG or graduate plot.

Table 8.3 Financial Analysis by Technology Type and Labor Use

Budget Item	Tech 1 Local seed, no fert.	Technology 2 Local seed plus DAP		Technology 3 Improved seed, DAP, and urea < recomm.		Technology 4 Improved seed, DAP and urea >= recomm.	
	T1.0	**T2.1** lower[1]	**T2.2** upper	**T3.1** lower	**T3.2** upper	**T4.1** lower	**T4.2** upper
n	4	21	22	28	28	25	25
1. Maize yield (kg/ha)	1835.00	2886.88	2921.77	4619.05	7060.26	5606.21	6237.74
1.a. Adjusted maize yield (kg/ha)[2]	1763.00	2829.72	2863.92	4527.59	6920.47	5495.21	6114.23
2. Farmgate price of maize (Birr/ha)	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return (3)	952.02	1528.05	1546.52	2444.90	3737.05	2967.41	3301.69
4. Total Variable Costs (5.+6.+7.+8.+9.)	705.90	682.85	1064.84	1235.16	1460.84	1500.77	1894.71
5. Total Package Costs (5.a+5.b.+...5.f.)[3]	49.00	249.59	349.44	534.20	562.48	710.50	730.49
5.a. Seed (Birr/ha)	49.00	33.14	44	107.6	113.08	142.97	147.04
5.b. DAP (Birr/ha)	0.00	216.45	303.74	219.35	230.23	291.85	299.41
DAP kg/ha	0.00	84.22	115.93	84.69	88.21	114.9	116.5
DAP Birr/kg	**0.00**	**2.57**	**2.62**	**2.59**	**2.61**	**2.54**	**2.57**
5.c. Urea (Birr/ha)	0.00	0.00	0.00	206.64	217.00	274.61	281.93
Urea kg/ha	0.00	0.00	0.00	84.69	88.21	114.90	116.50
Urea Birr/kg	**0.00**	**0.00**	**0.00**	**2.44**	**2.46**	**2.39**	**2.42**
5.d. Herbicide (Birr/ha)	0.00	0.00	0.00	0.00	0.00	1.07	0.00
5.e. Pesticide (Birr/ha)	0.00	0.00	0.00	0.61	0.00	0.00	0.00
5.f. Fungicide (Birr/ha)	0.00	0.00	1.70	0.00	2.18	0.00	2.11
6. Interest (Birr/ha)[4]	0.00	0.00	0.00	11.06	26.23	13.73	21.18
7. Labor (Birr/ha) (7.a.+7.b.)	387.00	240.50	532.58	448.11	468.95	458.22	830.31
7.a. Family & mutual labor (Birr/ha)[5]	351.00	217.22	484.43	396.18	371.43	418.55	770.49
7.a.i. Family & mutual labor days	78.00	48.27	107.65	88.04	82.54	93.01	171.22
7.b. Hired labor (Birr/ha)[6]	36.00	23.28	48.15	51.93	97.52	39.67	59.82
8. Animal traction (Birr/ha)[7]	261.00	103.13	92.38	100.3	186.65	146.13	122.12
9. Hand tools & sacks (Birr/ha) (9.a.+9.b.)	8.90	89.64	90.45	141.49	216.53	172.20	190.62
9.a. Tools (Birr/ha)[8]	3.10	3.03	2.80	2.92	4.72	4.01	3.49
9.b. Sacks (Birr/ha)[9]	5.80	86.61	87.65	138.57	211.81	168.19	187.13
Net Margin/Hectare (3.-4.)	246.12	845.20	481.67	1209.74	2276.21	1466.64	1406.97
Gross Margin/Hectare/Labor Day[10] (3.-4.+7.a.)/7.a.i.	7.66	22.01	8.97	18.24	32.08	20.27	12.72

On average technology type 3 received the highest net margin/ha (1,806 Birr/ha), compared to the net margin/ha of 1,439 Birr/ha for technology group 4 (primarily SG participants). The next section will discuss this finding further.

Given that the high-input technologies are considered relatively labor intensive relative to traditional technologies, a more appropriate measure of each technology treatment is to include the required labor days. In Table 8.3 the technology types are divided into halves by the level of labor application (family, extended family, and hired labor). Within each technology type, those farmers that applied the most labor also used the most DAP and urea–in keeping that fertilizer produces more weeds as well as additional grain for harvest.

8.2.2.1 Dominance and Marginal Analysis

A dominance analysis is conducted by listing the treatments in order of increasing costs to compare the costs and benefits of each treatment. Any treatment that has net benefits (i.e., net margin) that are less than or equal to those of a treatment with lower costs that vary (variable costs) is dominated and should be eliminated from consideration (CIMMYT 1998). The dominance analysis illustrates that the value of the increase in yield may not be sufficient to compensate a farmer for an increase in costs. In addition, the dominance analysis helps to eliminate inferior treatments and thus helps farmers and researchers move toward making a firm recommendation of which technological treatment is superior among the alternatives in profitability.

If the technology groupings are split by yield then no farmer would choose the dominated treatments T4.2[98], T4.1, or T2.1 (marked with a **D** in the net margin column in Table 8.4). This is because these treatments have higher variable costs compared to the previous treatment, but a lower net margin. All technology treatments listed are profitable but, the dominance analysis indicates which treatments are profitable relative to the alternative treatments.

The recommended treatment, among those listed, is T3.2 (improved seed, and less-than-recommended fertilizer). Although the MRR of T2.2 is higher (MRR of 377 percent) it is advisable that a farmer continue to increase the costs of inputs as long as the MRR is above the 100 percent threshold, because the net margin continues to increase. The lower yield half of technology type 3 (T3.1) is not profitable relative to the alternative technologies (MRR at 42 percent is below the recommended 100 percent).

Table 8.4 Dominance and Marginal Analysis by Yield Stratification

Technology Type	Net margin/ hectare (Birr/ha)	Total variable cost (Birr/ha)	Incremental net margin/hectare (Birr/ha)	Incremental variable cost (Birr/ha)	MRR (percent)
T4.2[1]	1917.2 **D**	1767.3			
T4.1	956.1 **D**	1628.5			
T3.2	2275.7	1461.3	1196.8	534.5	223.9 %
T3.1	1209.7	1235.2	130.8	308.4	42.4 %
T2.2	1078.9	926.8	832.8[2]	220.9	377.0 %
T2.1	219.8 **D**	827.1			
T1.0	246.1	705.9			

Notes: [1]Corresponds to technology type 4 (T4), the upper yield half (2).
[2]The difference between T2.2 and T1.0 because T2.1 is dominated and would not be a preferred treatment by a farmer.

[98]Technology types were spilt into two yield groups–lower and upper. T4.2 refers to upper yield half of technology type 4.

When the technology types are split according to labor use, the financial analysis looks very similar to when split by yields. No farmer would choose the dominated treatments technology 1, technology 2 (DAP, local seed), or technology 4 (marked with a **D** in the gross margin column in Table 8.5) because it is possible to increase returns over these scenarios (these treatments have higher variable costs than the previous treatment, but lower net benefits than one of the previous treatments).

Table 8.5 Dominance and Marginal Analysis by Labor Stratification

Technology Type	Net margin/ hectare (Birr/ha)	Total variable cost (Birr/ha)	Incremental net margin/hectare (Birr/ha)	Incremental variable cost (Birr/ha)	MRR (percent)
T4.2	1406.2 **D**	1895.5			
T4.1	1467.1 **D**	1500.3			
T3.2	2275.7	1461.3	1430.1[1]	778.8	183.6 %
T3.1	1209.7	1235.2	364.1[2]	552.7	65.8 %
T2.2	481.6 **D**	1064.9			
T1.0	246.1 **D**	705.9			
T2.1[3]	845.6	682.5			

Notes: [1]The difference between T3.2 and T2.1 because T2.2 is dominated and T3.1 is not profitable given a threshold of a MRR of 100%.
[2]The difference between T3.1 and T2.1, the lower-cost treatment that is not dominated.
[3]Usually the base treatment, T1.0, is the first listed in a dominance analysis. That is an anomaly of the data, explained by higher levels of expenditure on animal traction and labor by farmers in T1.0.

Among the alternative treatments of local or improved seed and varying levels of DAP and urea, the recommended treatment is technology type 3.2. The MRR of T3.1 is 66 percent, not a profitable investment relative to the alternatives, given the threshold for investment is a MRR equal or greater than 100 percent.

Thus the recommended treatment is to use improved seed and levels of DAP and urea lower than the SG-recommended levels (technology 3). By comparison, farmers do not profit from using DAP (technology type 2) without also adopting improved seed and urea. This is corroborated by evidence from the yield model in chapter 6 which showed that the combination of improved seed and fertilizer significantly increased yields over the local seed/fertilizer combination.

The SG recommended technology is profitable, but returns could be increased with lower levels of fertilizer. This result may be a result of poor farmer management practices and does not necessarily mean that the levels of inputs are too high (resulting in diminishing returns). Many of the farmers using the SG technology had no experience with the new technology, whereas many of the farmers in technology type 3 had at least one year of experience with the high-input package. Experience with the inputs on farm, and, as shown in the yield model in chapter 6, appropriate mixes of inputs and management practices, can be the key to maximizing returns.

8.3 Simulated Profitability from Cost-Reducing Subsector Changes

Fertilizer prices in 1998 were lower than the SG and NEP prices offered in 1997; however, the relevant question is whether prices could be reduced further with cost-saving institutional changes in the sector to improve the profitability of the high-input technology. Given that the SG farmers appeared better suited to use the high-input technology (chapter 6), their variable costs (e.g., greater access to family and mutual labor and animal traction) from investing in the high-input technology may be lower than the variable cost of farmers in the broader population. Thus if the high-input technology is profitable to the

SG farmers it may not necessarily be profitable to the less well-off farmers and farmers in lower agricultural potential areas.

In order to simulate 1997 farm budgets with cost-savings calculated from 1998 financial import parity price simulations, 1998 market fertilizer prices should be comparable to the financial import parity price. The 1998 financial import parity prices for Jimma Zone for DAP ranged from 249-258 Birr/quintal, compared to 244 Birr/quintal observed in the market (Table 8.6). The 1998 market was considered a "slaughter"–companies may have offered below-cost prices for the fertilizer auctions in Jimma Zone (GMRP 1998). For urea, the financial import parity prices ranged from 163-179 Birr/quintal, compared to 183 Birr/quintal in the market (GMRP 1998). In 1998, urea was in short supply, particularly in Amhara and East Shewa, Oromiya, which potentially could have increased prices (GMRP 1998).

Table 8.6 Comparison of Jimma Input Prices in 1997 and 1998 Across Programs, Birr/Quintal

	DAP Birr/quintal	Urea Birr/quintal
1997		
Technology type 4 (primarily SG current participants)	255	240
Technology type 3 (SG current participants and SG graduates, who	262	247
Technology type 2 (traditional plots)[2]	261	no urea used
1997 Government price	255	241
1998		
Input subsector survey observed market price[1]	242	182
Calculated financial import parity price at SG-participating	249-258	163-179

Source: Howard et al. 1999, NFIA 1998, and 1998 GMRP Input Subsector Survey.
Notes: [1] NEP participants received fertilizer and seed on credit from the NEP.
[2] Farmers using fertilizer on traditional plots obtained fertilizer either on credit through Service Cooperatives or on cash.
[3] Recorded for the same weredas in Jimma as the SG survey: Dedo, Kersa, and Seka Chekorsa, n=20 for DAP and n=9 for urea.

The changes in profitability from simulated cost savings from institutional changes in the fertilizer subsector appear small (Table 8.7). However, the cost savings in the expenditure on fertilizer can enable a farmer to use the savings to purchase more fertilizer or labor–inputs that may be particularly financially constrained.

Table 8.7 Simulated Changes in Profitability from Cost-Reducing Institutional Changes in the Fertilizer Subsector, Birr/ha

Scenario	Profit Measure	Tech 1 local seed, no fert.	Technology 2 local seed, DAP		Technology 3 imprv seed, DAP/urea< recomm rate		Technology 4 imprv seed, DAP/urea>= recomm rate	
		T1[1]	T2.1	T2.2	T3.1	T3.2	T4.1	T4.2
Base case	Net Margin/Ha	246	846	482	1210	2276	1467	1406
	Gross Margin/Ha/Day	7.6	22.02	8.9	18.2	32.07	20.3	12.7
(3) Reduced competition--if market was appointed by regional government officials (hedonic price model)	Net Margin/Ha	246	837	476	1185	2254	1422	1368
	Gross Margin/Ha/Day	7.6	21.8	8.9	17.9	31.8	19.8	12.5
(6) Improved transport timing, avoid port storage, improved import procurement	Net Margin/Ha	246	871	522	1319	2394	1603	1553
	Gross Margin/Ha/Day	7.6	22.5	9.4	19.5	33.5	21.7	13.6
(8) Reduced policy uncertainty (transport directly from port to retail market), avoid port storage, capture seasonal lows in intl. f.o.b. prices	Net Margin/Ha	246	875	529	1323	2398	1609	1558
	Gross Margin/Ha/Day	7.6	22.6	9.4	19.5	33.5	21.8	13.6

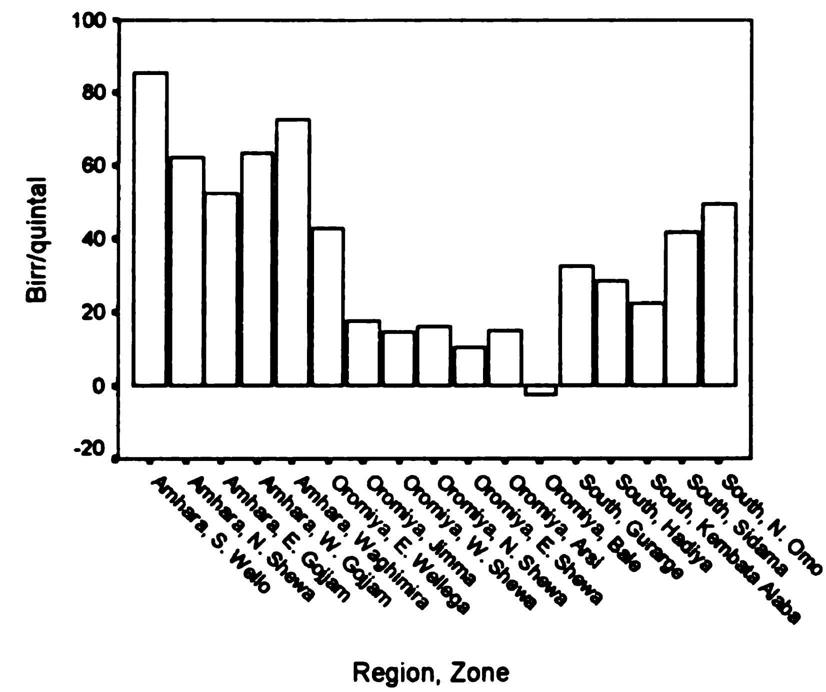
Note: [1]Same coding as table 8.2, technology types 1-4 are broken into 2 by level of labor use, T2.1 represents the lower yield half of technology type 2.

Due to the larger discrepancy between the observed market prices in 1998 and the calculated financial import parity price of urea the cost savings in the price of DAP are relatively small compared to the savings in urea. In addition, because Jimma Zone is relatively competitive and close to the calculated financial import parity price calculations under the assumptions of a competitive market, the observed changes in profitability are relatively small in Jimma compared to what can be expected in less competitive regions like Amhara.

As observed in figure 8.1, the observed 1998 urea prices, in general, were higher than prices calculated in the financial import parity price analysis for urea. This difference may be due to unaccounted transport rates or rents in the market. However, given published transport rates, the unidentified transport rates would not account for the full amount of the gap, over 80 Birr/quintal in some zones in Amhara. The difference was largest in the Amhara Region where Ambassel received monopoly rights and was relatively lower in Oromiya. However, the gap between actual prices and the financial import parity prices was higher across all regions relative to DAP.

Figure 8.1 Difference in the 1998 Urea Market Prices and Financial Import Parity Prices

Note: Bars represent the financial import parity price subtracted from the market price.



If the SG weredas had faced a government-appointed market, as in Amhara, and fertilizer auctions were not held, then the profitability of the SG technology would not be as high (scenario 3 in Table 8.7). Profitability would fall from 1-3 percent under improved seed, varying levels of DAP and urea.

Under the conditions of scenario 6, if the price of DAP and urea had been lower, farmers in technology type 4 (primarily the SG program) could have saved 282.3 Birr/ha on fertilizer. This sum is equivalent to 192 kilograms additional urea or 114.3 kilograms additional DAP. In scenario 8, the cost savings in fertilizer is 293 Birr/ha relative to the base case. Under the cost-savings from scenario 8 relative to the base case, technology type 2 could purchase an additional 14 kilograms of DAP and 21 kilograms of urea for all levels of labor, thus easing the budget constraint.

8.4 Conclusion

This chapter revealed that adopting high-input technologies–local or improved seed with DAP alone or with urea–is a profitable investment. However, when the alternative technologies are compared to one another, the recommended technology package is to use improved seed and levels of DAP and urea at levels lower than those recommended by the SG. Technology type 4 (primarily the SG participants using DAP and urea at rates greater than or equal to 100 kg/ha) was dominated, meaning costs increased over technology type 3, with the lower levels of fertilizer, but the net margin declined, and therefore, it would not be a treatment chosen by farmers.

Overall, the magnitude of changes in profitability from the proposed price reductions in fertilizer prices are small. In 1998 Jimma DAP prices were actually lower than the calculated financial import parity price, but urea prices were almost 20 Birr/quintal higher than the financial import parity price. As the hedonic price model showed in chapter 5, in less competitive markets, the price of DAP can be 10 Birr/quintal higher and the price of urea can be up to 21 Birr/quintal higher than prices in a relatively more competitive market such as Jimma.

CHAPTER 9

CONCLUSIONS AND POLICY IMPLICATIONS

Across Sub-Saharan Africa (SSA) governments are faced with the challenge of finding alternatives to government subsidies and pilot extension programs to maintain and increase high-input agricultural technology. Government programs are often overextended and once they withdraw agricultural support, high-input use may decline because the existing private sector input markets were not sufficiently developed to encourage sustained adoption. Thus at the dawn of the 21st century, the challenge remains of improving agricultural productivity, increasing food-security, and reducing rural poverty in SSA.

Ethiopia provides evidence of one country's experience with the challenge of introducing improved, profitable agricultural technologies to farmers through an expanded Sasakawa-Global 2000 high-input technology program (the NEP); and simultaneously developing input and credit markets that will ensure widespread, sustainable adoption of these technologies. Evidence suggests that although much progress has been made, the preconditions for long-term productivity growth for maize in Ethiopia are not sufficiently developed.

9.1 Conclusions

The FDRE is experimenting with one approach to promoting rapid productivity growth through an extensive extension program (the National Extension Program) whereby farmers are provided extension, and improved seed and fertilizer on credit. The program is far reaching and dominates the input market. In 1998 the NEP enrolled 2.9 million households and planned to target 3.6 million farmers in 1999 (42 percent of rural households). In 1998 almost 80 percent of fertilizer imports were channeled into the NEP. Participation in the NEP in 1998 was heavily encouraged by the national and regional governments. Participation in the NEP was the only viable source of fertilizer and improved seed on credit in areas where it operated, which served to facilitate the NEP's efforts to rapidly increase the numbers of participating farmers. Another factor that helped extension agents meet NEP targets was that in some areas of the country the open market for fertilizer was actively suppressed by regional government authorities (e.g., governments locked warehouse doors of small retailers and threatened farmers not to purchase fertilizer). The FDRE's approach to encouraging productivity growth is characterized by heavy government involvement in all stages of the input sector--from quantities of import, to allocation of credit and fertilizer market shares--to even setting retail prices.

Evidence from other countries (e.g., Ghana, Tanzania) suggests that although the NEP may be able to increase the level of input use in the short-run, Ethiopia's approach may not be financially viable in the long-run and therefore, the country risks losing potential productivity gains made under the NEP. This research demonstrated that the

NEP may not necessarily provide an efficient system of extension, credit, and input delivery--key elements for long-term agricultural productivity growth.

Extension. There were warning signs in 1998 that the quality of the extension service may have been compromised by the rapid expansion of the NEP. Quality extension will be crucial to high-input adoption because it reduces the production risk of the new technologies, thereby improving its profitability. An econometric yield model (chapter 6) showed that management practices (interaction between timing of weeding and level of input use) were key to optimizing yields under the higher-input technologies. It was found that the level of DAP used by farmers that used local seed and DAP was sub-optimal, given their seeding rate, perhaps due to a liquidity constraint, but also perhaps because of lack of information.

In another example, it was found that there is a production risk associated with fertilizer use (with local seed). Use could actually result in reduced net margins and returns to labor compared to when a farmer uses local seed and no fertilizer (chapter 8). This is a concern because Jimma Zone represents a high-potential maize area and the SG participants were characterized as being relatively well-suited to use the high-input technologies efficiently compared to the broader population. If these farmers face reduced benefits in adopting fertilizer then it is likely that the broader population will not find the new technology profitable. Farmers that do not receive adequate extension advice or do not own or have access to oxen in timely manner (assuming the net effect of oxen use raises returns to labor) may be particularly susceptible to this risk.

Overall, as the high-input technology is expanded to a broader population, maintenance of a quality extension service, as well as provision of area-specific technological recommendations will become increasingly important. The CERES-maize biological simulation model can be used to determine the success of the SG technologies under conditions of moisture stress and sub-optimal management practices (Schulthess and Ward 1999).

It is questionable whether the NEP can provide a high quality extension message that would ultimately increase the profitability of the new technologies (through higher yields, *ceteris paribus*). As the NEP expands, the ratio of extension agents to farmers decreases, thus diluting the close supervision afforded farmers in the SG program. An additional concern regarding the quality of extension is that the extension agents in 1998 were increasingly burdened with non-extension activities (e.g., organizing credit) that distracted from the delivery of the extension message.

Credit. In 1998 the regional governments' organization of NEP input credit led to concerns regarding the performance of the input and credit markets. In 1998 there remained an unmet demand for fertilizer and improved seed outside the NEP that was not allowed to be met by neither an open market for credit nor an open market for fertilizer. Credit resources were limited: many program "graduates" remained in the program due to limited opportunities for purchasing inputs outside the NEP program, however, this policy reduced the NEP's ability to reach non-adopters. Additionally, as mentioned, the fertilizer open market was thin and there was virtually no improved seed available in the open market.

Another concern regarding credit was that the regional governments controlled which fertilizer distributors could supply the NEP, the respective market shares of the distributors, and to some extent, their retail prices. Thus, the choice of supplier for farmers that purchased with NEP arranged credit was determined by the regional governments. Due to the fact that government guaranteed input credit, most large distributors preferred to channel their stock through the credit programs because it shifted the risk of marketing from retailers to the government. However, because the government relied upon multiple public institutions to process credit and input delivery, fertilizer delivery was often delayed. Delays add a cost to distributors (e.g., storage and interest) as well as to farmers. At the time that farmers realized delivery was going to be late, they were already committed to accepting the input package, and therefore the profitability of fertilizer is reduced because late fertilizer application can reduce yields.

Fertilizer and Seed Markets. As with extension and credit, evidence suggests that costs in the fertilizer and seed markets could be reduced in 1998 to warrant sustained high-input use. In some areas of the county fertilizer prices were high relative to competitive market conditions, and fertilizer was both delayed and poor quality (thus raising its price to farmers). A hedonic fertilizer price model demonstrated that fertilizer prices were lower in regions of the country which were relatively more competitive than government-appointed markets (10 Birr/quintal for DAP and 21 Birr/quintal for urea) (chapter 5). The financial import parity price calculation (chapter 7) calculated the magnitude of the gap between observed 1998 market prices and the price level that society could reasonable expect under competitive market conditions at every stage of the subsector. It was discovered that the gap was more pronounced for urea than DAP, and in Amhara for both urea and DAP relative to other regions.

Overall, high-input technology use is a viable approach for achieving productivity growth because the technology works. This issue is, however, how to deliver these techniques to farmers in a cost-effective and sustainable way. This involves providing the incentives for long-run private investment and involvement. Simulated farm budgets from Jimma Zone (chapter 8) revealed that the profitability of the SG technologies was robust at all yield levels and levels of labor use. However, it must be remembered that Jimma is a relatively competitive, high-potential maize production area. It is recommended that a profitability analysis be conducted in years with less favorable rainfall than 1997 (1997 was a relatively good rainfall year).

Profitability of fertilizer was less robust for the partial adopters (local seed and DAP); however, still profitable relative to the local seed/no fertilizer option. The robustness of the technology is increased further through proposed cost savings in the fertilizer subsector. Costs can be reduced through institutional changes in how fertilizer is distributed through the government credit programs, but it was also revealed through qualitative survey evidence and statistical analyses that retail prices of fertilizer can be reduced by reorganizing government policies regarding import and distribution such that the private sector is able to take advantage of seasonal prices in international fertilizer prices as well as in domestic transport rates. It was found that the retail prices in Jimma could be reduced by up to 10.5 percent for DAP and 9.8 percent for urea relative from the 1998 financial import parity price calculation of a competitive market. The proposed cost reductions in the fertilizer subsector may be relatively more critical to improving profitability in areas such as Amhara rather than Oromiya because prices in Amhara are relatively higher because distributors are appointed by the regional government.

9.2 Policy Implications

Alternative strategies exist to forging a sustainable system of input delivery, credit, and extension growth in Ethiopia than that chosen by the FDRE. However, the distributions of benefits and costs will differ considerably under alternative strategies. The FDRE has adopted a command approach to introducing high-input technologies to farmers. The government-favored companies will lose rents if the government shifts to an approach whereby the government specializes in introducing high-input technologies (through provision of extension, credit, and facilitated input delivery), but simultaneously encourages increased private sector participation such that farmers are able to use the high-input technologies with the government's assistance on a sustained basis. The FDRE will also incur a cost if it actively pursues to gain "ownership" over the donor import-support program–by encouraging increased flexibility in import conditions as well as in timing. However, there are benefits--including a more equitable distribution of returns, increased agricultural production, potentially reduced expenditures on domestic food security programs, and even increased savings in hard currency (from reduced grain imports or increased receipts from grain exports).

An option for long-term productivity growth includes:

- Encouraged private sector input market investment;

- Improved access to credit by importers, distributors and farmers;
- Assurance that the NEP is financially sound; and
- Maintenance of a quality extension service.

Encourage Private Sector Investment. Overall, FDRE actions in the input markets in 1998 were not characteristic of a government promoting the development of a low-cost, open, transparent market. Government-favoritism prevailed, policy uncertainty was commonplace, and access to credit and markets was tightly controlled. Such an environment does not invite private sector investment. The degree of private sector frustration and losses in the market in 1998 was extreme: one fertilizer importer and distributor (one of the two truly private firms) announced its planned to withdraw from the market in 1999. The government may not realize that its predetermination of timing of imports, quantities of fertilizer consumed (based upon NEP targets), and market shares of distributors can increase costs in the market.

In Ethiopia the private sector has never been provided the opportunity to invest in the input market (particularly for improved seed). This research revealed that increased private sector participation and autonomy with regard to timing of operations and access to credit and input markets can realize cost savings in the inputs market (chapter 7). The NEP is characterized by high prices in some areas and late deliveries (because it relies upon various institutions for organization of credit and input delivery). In contrast, the private sector has shown that it is quick to respond to market opportunities. Survey evidence revealed that the cash market was vibrant in areas where the NEP was limited in scope or non-existent (GMRP 1998). In other areas, independent retailers felt that their business had been restricted by the expansion of the government credit through the NEP.

The private sector can be encouraged to invest in input distribution by allowing open market retailers to sell inputs to farmers in the government credit programs and permitting the open market retailers to decide their market strategies and selling prices. The government may decide to step in where the private sector fails to operate--perhaps in low-potential agricultural areas, for example.

The fertilizer auctions are relatively more competitive than the government-appointed markets; however, the auctions are not a viable method of promoting increased investment in the inputs markets. If a retailer loses a tender for an auction and his or her stock is already in the area then there is a cost to redirecting that stock and a risk that markets in other regions are already saturated. Ironically, a tacit requirement by regional governments for participation in the auctions to have stocks in the region and to have an established transport and warehouse network (GMRP 1998). Thus, independent retailers are not permitted to participate in the auctions and larger integrated retailers are also shut out of markets in which they have invested in fixed assets such as warehouses. This is a concern because the fertilizer market outside the NEP is thin and underdeveloped.

Overall, underlying the development of any efficient market is established markets rules and property rights. In 1998 there was ample evidence to suggest that neither factor was sufficiently developed in Ethiopia–markets were often unexpectedly closed to distributors. As any society moves from subsistent agriculture to increased productivity through specialization and hence, a greater reliance on purchased agricultural inputs, the role of coordination across markets and between stages of a market becomes increasingly important.

Given economies of scale, there may be limited scope for increased competition at the import level. However, increased flexibility in terms of timing of imports--achieved through legalized foreign credit, open access to forex auctions, and pooled donor funds--can lower import costs. The primary constraint with regard to import is the availability of hard currency, thus forex tenders are scheduled when any one donor provides funds. If donors want to continue to provide forex specifically for fertilizer (keeping it separate from the weekly forex auctions) then perhaps they could pool their resources in order to provide a more timely schedule of forex auctions to capture the seasonal lows in international prices.

Monitor the NEP's Financial Sustainability. Howard et al. (1999) found that the NEP is economically profitable given that domestic maize production substitutes for commercial imports, however, less so if the policy objective is to export maize. Thus for the NEP to continue to have a net benefit for society, it is critical that it is able to control its costs, in addition to maintaining a high-quality extension service that ensures that yields are maximized.

However, there were signs in 1998 that perhaps the "economic" analysis did not cover all costs imposed on society by the NEP and therefore the NEP may not be financially sustainable in the long-run. For example, in 1998 there was evidence that many of the program costs were not being sufficiently covered (e.g., local governments were not compensated for providing storage and transport facilities to the NEP). In addition, improved seed was subsidized. The NEP sale price was considerably higher than Pioneer Hi-Bred International Seed Company's quoted price in 1998 (for importing basic seed and duplicating it in Ethiopia) (GMRP 1998).

The degree to which the current fertilizer market is subsidized and hence whether costs in the long-run will increase is an issue for sustainability of the inputs. It is speculated that former government assets (e.g., trucks and warehouses) were transferred to government-affiliated companies (on concessionary terms or as gift) and thus, the sector may not reflect the full cost of investing in the inputs market. As these assets depreciate and investment in new assets occurs, costs in the inputs markets may rise. Another concern is that, assuming repayment rates of input credit are less than 100 percent, the FDRE subsidizes credit. Over time, accumulated government losses may restrict its ability to continue to extend credit, resulting in reduced input use because alternative credit institutions are not well developed.

One method of keeping program costs down and improving the quality of extension is to ensure that program "graduates" can continue the high-input practices after two years in the program and are not "carried" in the program year after year, as was the practice in 1998. There was evidence in 1998 that farmers can and will purchase inputs on cash (chapter 7). Another idea is for the NEP to focus greater attention to providing quality extension, thus reducing the production risk facing farmers, crop failure, and ultimately, credit default. The NEP has been using "model" farmers and volunteers to assist in extension, however, the quality of the message may be higher if trained extension agents are able to visit all participants.

Overall, this research has implications for other SSA countries struggling to simultaneously increase food productivity growth through increased high-input use and liberalize credit, input, and output markets. The task is not easy, but facilitated by basic tenets of development as learned by more developed countries: established property rights and rules of the game, and competition are central.

Donors have an important role to play. In Ethiopia, although pan-territorial prices were no longer set by the government in 1998, access to inputs and competition did not necessarily increase. It was a superficial measure to "liberalize" markets. Donor oversight or compliance with limited input market liberalization is to the detriment of the Ethiopian farmer. Continued donor provision of import support for fertilizer will not necessarily ensure long-term productivity gains.

The FDRE is commended for tackling an age-old problem: farm credit. The government has provided inputs on credit and is thus far successful (through use of local police) in maintaining high repayment rates (Howard 1999); however, credit is only one component of the development of a complex web of interlinked markets that are required for sustained productivity growth. The government is encouraged to give the private sector a chance to participate in the development process.

APPENDICIES

APPENDIX 1

GMRP INPUT SUBSECTOR SURVEYS AND COVERAGE

Five separate survey instruments were used:

Table 1. Coverage of GMRP 1998 Input Subsector Survey, 208 Surveys in Total–at least one Bureau of Agriculture Survey for each wereda, followed by a survey of a Service Cooperative

Region	Zone	Wereda (Number of surveys in parentheses)
Amhara	West	Bure (3), Wonbera (4), Yilmana Densa (4), Dembecha (5)
Amhara	East	Machakal (5), Gozamin (4)
Amhara	Awi	Banja (2), Shikudad (4), Dangla (3)
Amhara	South Welo	Kalu (1)
Amhara	North Shewa	Gidem (4), Efiratana (4), Ensara and Wayu (1), Moret and Jiru (2), Basona Worena (2), Ensaro and Wayu (1), Denaba (1)*
Oromiya	North-West Shewa	Sululta Milo (2), Kimbibit (2), Girar Jarso (3), Wucale (2), Bure-Aleltu (), Sendefa, Wonchi, Woliso ( )
Oromiya	East	Ada (5), Shashemene (5), Lume (3), Arsi-Negele (2), Adama (5)
Oromiya	West Shewa	Ambo (6), Alemgena (4), Dandi (4), Ejere (2), Ilu (2), Becho (3), Chaliya (5)
Oromiya	Jimma	Manna (3), Seka Cherkorsa (2), Oma Nada (3), Kersa (2), Dedo (1), Asandabo
Oromiya	Arsi	Tiyo (5), Gadab (3), Kofele (2), Dodola Sire (2), Digelu Tijo (2), Dhera (1), Hitossa (3), Lemu Bilbido (4)
Oromiya	Bale	Dodola (3), Adaba (3), Sinana Dinsho (3)
Oromiya	East Wellega	Guto Wayu (2), Anno (1), Bulu Sayo (1), Guduru (1), Sire (5)
Southern (S.N.N.P.R.)	Hadiya	Lemu (7), Badawacho (3)
Southern (S.N.N.P.R.)	Gurarge	Goro (3), Mekana Maroko (3), Checha (1)
Southern (S.N.N.P.R.)	Sidama	Aleta Wondo (1), Awassa (2)
Southern	Kembata	Alaba (4), Kachabira (3), Kedida Gemela (2)
(S.N.N.P.R.)	North Omo	Sodo Zuria (4), Bolosso Sore (3), Domot Gale (2)

*Only one survey, an independent retailer.

Zone____________________Wereda____________________Date_____________

1998 Input Subsector Survey Questionnaire
Bureaus of Agriculture

The objective of this survey is to (1) understand how the organization and performance of the input subsector has evolved in response to recent changes in macro-economic and sectoral policies affecting the agricultural, transport, and fertilizer sectors and (2) to evaluate the potential for cost reductions in the fertilizer sector that could ultimately lower farmgate fertilizer prices, thereby increasing fertilizer demand. Our main role is to understand the situation for designing a questionnaire for the forthcoming study. We would also make recommendations to the government about what types of policies and investments can be made to improve the efficiency of the fertilizer sector and increase fertilizer demand.

I. Respondent ID and characteristics

1. Position of respondent: ____
2. How long has respondent been in this position:__________________________________

II. Overview of the input market in this area

1. What is the role of the bureaus of agriculture with respect to inputs in this area?
    1. Fertilizer purchases and sales
    2. The distribution and dissemination of improved seeds
    3. The distribution and dissemination of of chemicals
    4. The distribution and dissemination of farm implements
    5. The distribution and dissemination of heifers and improved livestock technologies
    6. The distribution and dissemination of soil conservation and forestry technologies
    7. The distribution and dissemination of other technologies (specify)

2. What are the main components/inputs of the extension package in the woreda with respect to:

    Belg crop production
    Meher crop production
    Horticultural crops
    Modern storage
    Livestock husbandry
    Natural resource conservation and forestry

Zone__________________Wereda___________________Date____________

Introduction of new crops
Introduction of irrigation schemes
Others (specify)

3. What are the procedures for getting inputs to **farmers participating in the <u>government extension program</u>**?

1. How are farmers selected?
2. How and when are quantities of inputs for the program determined?
3. Who collects the down payments____________________ and the final payments______________?
4. Who keeps the records of inputs received____________________ and payments made________________?
5. Who (what distributor) supplies the inputs? fertilizer________________;seed_____________;pesticides and herbicides______________; other____________
6. How are the distributors selected? If it is a bidding process, who organizes the bids and how many bidders were there this year?
7. How many distribution points for extension packages are there in the wereda?
8. Were all the inputs for the packages delivered to the wereda on time this year? If not, what were the problems?

4. Did the SG program provide farmers in your woreda with inputs in the past? (yes/no) ___________

If yes, how did that distribution system differ from the one for the government extension program described above?

5. How much fertilizer (in quintals) was sold in this woreda? **Note quantities in NEP and Regular Credit program if possible**

	1995 (1987)	1996 (1988)	1997 (1989)	1998 (1990) so far.....
DAP				
urea				

6. How is it determined how much fertilizer should be supplied to your area?

7. What are the main problems with respect to fertilizer distribution ? (For example, timing, quantities, credit, etc.)
   1.
   2.

Zone__________________Wereda____________________Date_____________

3.

III. Details of participants in the fertilizer market in this area

1. How many of the following operate in this woreda? importer/distributors __________

   independent retailers/wholesalers_____________
2. How many sales centers (places at which farmers collect their fertilizer purchase or shiyach tabia) are there in the woreda? ____
3. How many SCs are there in the woreda? _______________
4. Where are the independent retailers/wholesalers located? (Get enough info so that you can locate them for the survey)

   Woreda______________________

   Market town_________________

   Rural area__________________
5. Have you seen fertilizer trade increase or decrease in this area in the last 5 years?
6. If there has been a change, what is this change attributed to?
7. Is the SG-2000 program functioning in your area this year? (yes/no) _________
8. What are the principal activities of the SG-2000?

9. What is the range of distance farmers travel to pick up fertilizer from:

	Min. kms.	Max. kms.
the SCs:	___________	___________
the importer/wholesaler sales outlet:	___________	____________
the government extension program:	___________	____________

10. What is the different modes of transport used by farmers to transport fertilizer from the above locations

    ____ pick-up (1=common, 2=sometimes, 3=never)

    ____ car (1=common, 2=sometimes, 3=never)

    ____ ox-cart (1=common, 2=sometimes, 3=never)

    ____ pack animal (1=common, 2=sometimes, 3=never)

    ____ bicycle (1=common, 2=sometimes, 3=never)

    ____ on foot/human load (1=common, 2=sometimes, 3=never)

    ____ other (specify) _________________

    (1=common, 2=sometimes, 3=never)

11. We understand that fertilizer traders are required to have a license. Is the agricultural bureau involved in:

    issuing licenses (yes/no) __________

    verifying licenses (yes/no) __________

Zone__________________Wereda___________________Date____________

12. If the agricultural bureau is involved in issuing licenses, what is the procedure?
13. If the agricultural bureau is involved in verifying licenses, what is the procedure?
14. If this agricultural bureau does not participate in these activities, where do these activities occur (at killil level?):
    issuing licenses ________________
    verifying licenses _______________

IV. Credit

1. What is the role of the bureau of agriculture with respect to fertilizer credit?
2. Describe the process of obtaining credit in this area (what does farmer do, SC, ag bureau, zone bureau, finance bureau, others?).
3. If the allocated amount of credit is less than the quantity demanded, then what adjustments do you make in allocating fertilizer?
4. How many bank branches are located in this woreda?
5. What was the average level (or percent) of down payment for fertilizer purchases in each of the following years?

Program	1995 (E.C. 1987)	1996 (1988)	1997 (1989)	1998 (1990)
Extension				
Regular				

6. During the last 4 years, has fertilizer credit received by the wereda ever been less than what was necessary to cover fertilizer demanded by farmers?
7. If yes to 6., how did you deal with the situation?
8. What is the extent of cash sales for fertilizer in the woreda (estimate the % in the total sales)?

Zone__________________Wereda__________________Date____________

1998 Ethiopian Fertilizer Subsector Survey Questionnaire, July 1998
Service Cooperatives (SC)/Farmer Associations (FA) and Salaried Retailers/Manager

The definition of a salaried retailer/manager is one who works at the stores for an importer/wholesaler for a fixed salary.
We would like to talk to a Member of the SC committee.

"Thank-you for agreeing to participate in this survey. I need to begin by getting some general information about you and your firm."

I. Respondent ID and characteristics

1. Name of organization: ____
2. **FOR SC/FA:** Respondent's position (circle one) 1. manager
   2. sales clerk

3. For how long has the respondent been in this position? ______months and ______years

4. Education of respondent: Formal schooling in number of years: primary____ secondary_____ technical________university ________

   Other types of training: type______________________ years____________

   Did the respondent receive special training related to fertilizer use or sales? (yes/no) ______ If yes, explain. (magnitude)

5. What are the months in which you work in fertilizer activities? (Circle the number(s) below corresponding to the month in the Ethiopian calendar)

   Months 1 2 3 4 5 6 7 8 9 10 11 12 13 [circle]

6. Is this the same time as in previous years? (yes/no) _________ If not, explain changes.

7. **FOR SCs/FAs:** What other services do you offer to your members?

Zone__________________Wereda___________________Date_____________

II. **"Now I would like to get a picture of the fertilizer retail trade in your area of operation."**

1. **FOR RETAILER:** Has the competition you face from other retailers or distributors increased, decreased, or remained the same since you became involved in fertilizer?
2. If there has been a change, to what do you attribute it?
3. From how many kilometers away do your clients/members come to get fertilizer? (Give the range in kilometers from those that travel the farthest to those that are closest)
4. **FOR SCs/FAs:** Do farmers in your area participate the NEP program? (yes/no)

   ____

5. Is it any more difficult to get NEP inputs than regular inputs? Have there been any problems?
6. Who are the input distributor(s) for the NEP program in your wereda?
7. Do all retailers in this wereda sell to farmers at the same price? (yes/no)

   ____

   If not, explain the differences.

III. **Quantitative questions about overall fertilizer activities**

8. How much have you stocked this season, 1990? (1998?)
   DAP ______ quintals
   urea ______ quintals
9. What were your carryover stocks from 1989? (1997?) (last season?)
   DAP ______ quintals
   urea ______ quintals
10. How much have you sold so far in this season, 1990? (1998?)
   DAP ______ quintals
   urea ______ quintals
11. What are your anticipated carryover stocks this season, 1990? (1998?)
   DAP ______ quintals
   urea ______ quintals
12. What is the sale price for:
   For credit sales (DO NOT INCLUDE INTEREST)
   DAP minimum price _______, maximum price _______,
   always _______ birr/qt
   urea minimum price _______, maximum price _______,
   always _______ birr/qt

Zone________________Wereda________________Date__________

For cash sales

DAP minimum price ______, maximum price ______, always ______ birr/qt

urea minimum price ______, maximum price ______, always ______ birr/qt

13. **For SCs/FAs:** What is your margin per quintal of fertilizer? _______birr

14. FOR SCs/FAs: How many fertilizer-using members are there in your SC/FA? _______

15. **FOR SCs/FAs:** What was the timing of the following activities for this year?

	Month begin	Month end
Report fertilizer needs to agricultural bureau		
Collect down payment for credit		
Arrival of fertilizer at SC/FA		
Sales to farmers		

16. What are the terms of the credit provided to farmers?

Is there a down payment? (yes/no) __________

If yes, the most 1. lowest % _________

2. highest % _________

3. common % ________

Annual interest rate? __________

Duration of loan? __________

Other details __________

17. FOR SCs/FAs: What is the repayment recovery rate of your members for last year?

How many paid ________, How many did not pay __________

18. **FOR SCs/FAs:** What determines whether you can receive credit next season? (what percent of loan is required for payback? 100%?)

19. **FOR Scs/FAs:** What do you do to enforce repayment?

Zone__________________Wereda__________________Date____________

"Now I would like to understand the process that you must follow to obtain your fertilizer supply, market it, and management of stocks."

IV. Fertilizer procurement

1. **FOR SCs/FAs:** Who was your supplier for DAP? ______________________ for urea? ________________________
2. **FOR SCs/FAs:** Are the (1) fertilizer supplies delivered to you or (2) do you have to collect the fertilizer supplies on behalf of the farmers? (circle one)
3. **FOR SCs/FAs:** If you do have to collect fertilizer supplies, how many km did you have to go for DAP ___________, for urea ____________
4. **FOR SCs/FAs:** Did you hire transport? (yes/no) ______
5. **FOR SCs/FAs:** If you did **not** hire transport, how do you collect the fertilizer?
6. **FOR SCs/FAs:** If transport was **hired** by you to collect fertilizer, could you give us the details of different examples of collection:

	origin	destination	kilometers	total quantity	transport cost (specify units)	loading costs	off-loading costs	month
1.								
2.								
3.								

7. What were the biggest problems you encountered in **getting** your fertilizer supplies this year?
   1.
   2.
   3.
   4.

8. Is there anything that you can do differently next year to avoid these problems?
   1.
   2.
   3.
   4.

9. Is there anything that other actors in the fertilizer sector (importers, retailers, government, extension agents) can do to reduce these problems?
   1.

Zone____________________Wereda____________________Date_____________

2.
3.
4.

V. **"We would now like to ask a few questions about your sales."**

1. **FOR SALARIED RETAILER ONLY:** Has your company done anything to encourage farmers to use more fertilizer? (circle one for each)

Advertising
1 - sometimes, 2 - often, 3 - never
Repacking fertilizer into smaller bags than the standard
1 - sometimes, 2 - often, 3 - never
Using roving agents
1 - sometimes, 2 - often, 3 - never
Demo fields
1 - sometimes, 2 - often, 3 - never
Price reductions
1 - sometimes, 2 - often, 3 - never
Credit flexibility
1 - sometimes, 2 - often, 3 - never
Offering advice on how to use products
1 - sometimes, 2 - often, 3 - never
Deliver fertilizer to farms
1 - sometimes, 2 - often, 3 - never
Offer prearranged farmer specific contracts to deliver a specified amount on a certain date
1 - sometimes, 2 - often, 3 - never
Promote cash sales
1 - sometimes, 2 - often, 3 - never

2. Was there ever a period when farmers wanted fertilizer and you had none in stock? (yes/no) ____________

3. If yes to 2., what was the source of the problem?

4. Has the volume of sales expanded, contracted or remained the same over the last 5 years? ____________________

5. If there has been a change in the volume of sales, to what do you attribute it?

6. How much have you sold this year in:
cash ___________ quintals (both DAP and urea)

Zone____________________Wereda_____________________Date______________

credit ___________ quintals (both DAP and urea)
in-kind ___________ quintals (both DAP and urea)

7. What were major problems that you encounter in your fertilizer **sales** this year?
Problems to mention for prompts: Unexpected costs, delays in delivery to clients, complaints about fertilizer quality, dissatisfied clients, delays in payments by clients, other.
1.
2.
3.
4.

8. Is there anything that you can do differently next year to avoid these problems?
1.
2.
3.
4.

9. Is there anything that other actors in the fertilizer sector (importers, retailers, government, extension agents) can do to reduce these problems?
1.
2.
3.
4.

10. What has been your experience with cash sales? Do they pose different problems than credit sales? If yes, explain.

Zone__________________Wereda___________________Date_____________

Ethiopian Fertilizer Subsector Survey Questionnaire, July 1998
Independent **Retailers and Wholesalers**

Definitions: *Independent* operators are ones who purchase their own supplies of fertilizer and resell them.

Wholesalers have annual turnover of 150 to 3000 tons; they get supplies from distributors and do not go to the port themselves.
Retailers have annual turnover from 10 to 150 tons; they get supplies from distributors (?) or wholesalers.

This questionnaire is designed for the owner of the retail or wholesale operation. If you encounter a manager or a sales agent, administer the questionnaire for salaried retailers instead of this questionnaire.

III. Respondent ID and characteristics

1. Respondent's name:___________________________Name and type (ret/whole) of firm: ______________________________
2. Respondent's position in the firm A. owner
   B. manager
   C. other ________________
3. What type of operation is involved: (circle applicable response)
   1. Purchases supplies from multiple distributors
   11. Purchases supplies from only one distributor
4. How many sales outlets do you have?
   I. In this wereda?
   2. In other wereda? (specific names of other wereda).
5. Education of owner:
   Formal schooling in number of years: primary____ secondary_____
   technical________university _______
   Other types of training: type__________ years____________
6. We would like a few details about how you got started in your fertilizer business.
   a. What year did you begin trading fertilizer? ________
   b. When did you leave the fertilizer business? _______
   c. First location of operation:_________________
   d. How did you get the idea to become a fertilizer dealer?_________________________
   e. Time elapsed between the first active step to starting up business and first sales
   f. Paperwork involved? Specify amount of time in days/weeks/months required for each activity?

Zone__________________Wereda___________________Date____________

(1) Obtaining License
(2) Obtaining Other Necessary Permits
(3) Obtaining Financial capital
(4) Training ________ _________________
(5) Other (specify)

7. If someone wanted to start a retail fertilizer business in this area now would it be easier, more difficult, or about the same level of difficulty as when you started in your business?
8. What are the months in which you work in your fertilizer business? (Circle the number(s) below corresponding to the month in the Ethiopian calendar)
   Months 1 2 3 4 5 6 7 8 9 10 11 12 13 [circle]
9. What other business do you operate? (yes or no)
   1. grain trade ______ 4. transport service _____
   2. merchandise trade ______ 5. farming (livestock) _____
   3. flour mill ______ 6. others _______________
10. Which of the businesses in question 9. function at the same time as your fertilizer business (list numbers from question 9)?
11. Why did you leave the fertilizer business? Please explain in detail. (Ali, Did he lose money or is it not as profitable as other activities?)

12. Would you ever re-enter the fertilizer business? (yes/no) ___________
13. Under what conditions would you re-enter the fertilizer business?

"Now I would like to get a picture of the fertilizer trade in your area of operation."

14. From how many km away do your clients come? (Give the range in kilometers from those that travel the farthest to those that are closest)

15. How many other dealers sell directly to farmers or farmers associations in this wereda?
    1. Independent retailers or wholesalers (Purchase own stocks)
    2. Wholesalers/distributors outlets (Salaried staff sells stocks owned by one of major importer/distributors)
    3. Others (specify)
16. Has the competition you face from other dealers increased, decreased, or remained the same since you began your business?
17. If there has been a change, to what do you attribute it?
18. Do you sell at the same prices as other dealers in the wereda? If not, explain the differences and any problems these differences create for you.

Zone__________________Wereda___________________Date____________

Quantitative questions about overall fertilizer retail business

19. How much have you purchased this season, 1990? (1998?) **DAP** ______ **urea** ______

20. What were your carry over stocks from 1989? last season? **DAP** ______ **urea** ______

21. How much have you sold so far in this season, 1990? (1998?)? **DAP** ______ **urea** ______

22. What are your anticipated carryover stocks in this season, 1990? (1998?) **DAP** ______ **urea** ______

23. What are the minimum and maximum prices you paid for fertilizer **purchases** since last season, September 1989 in which **you took delivery at the distributors?**

DAP	minimum price _____	maximum price ____
	always at _______ birr	no such cases______
urea	minimum price _____	maximum price ____
	always at _______ birr	no such cases ______

24. What are the minimum and maximum prices you paid for fertilizer **purchases** since last season, September 1989 in which **fertilizer was delivered to you**?

DAP	minimum price _____	maximum price _____
	always at _______ birr	no such cases ______
urea	minimum price _____	maximum price _____
	always at _______ birr	no such cases_______

25. What are the minimum and maximum prices you charged for fertilizer **sales** which farmers picked up at your store this year?

DAP	minimum price _____	maximum price _____
	always at _______ birr	no such cases_______
urea	minimum price _____	maximum price _____
	always at _______ birr	no such cases_______

26. What are the minimum and maximum prices you charged for fertilizer **sales** which you delivered to farmers at their village this year?

DAP	minimum price _____	maximum price _____
	always at _______ birr	no such cases_______
urea	minimum price _____	maximum price _____
	always at _______ birr	no such cases_______

Zone__________________Wereda__________________Date____________

27. Has the geographic coverage of your fertilizer business expanded, contracted or remained the same since you began operations? ____________
28. If there has been a change, to what do you attribute it?
29. What is the minimum margin between purchase price and sales price that you could accept and still make a reasonable profit. ______________
30. If your **volume of sales doubled**, could you accept a smaller margin?

"Now I would like to understand the process that you must follow to obtain your fertilizer supply, market it, and take care of any unsold stocks. I'm particularly interested in the timing of the key activities, the costs associated with each, and how the process has changed during the last 5 years."

Fertilizer procurement

31. What determines **when** you purchase your fertilizer and **how many** times you purchase during the year
32. How do you determine from whom you will purchase the fertilizer?
33. How is your purchase price determined? (Circle the one that is most common)
    A. Set by supplier
    B. Negotiated between yourself and supplier privately
    C. Other, explain
34. Could you get a quantity discount if the size of your purchases were larger? If so, explain relationship between quantities and prices.
35. If quantity discounts are possible, what prevents you from increasing the size of your purchases?
36. Does the month of the year in which you purchase fertilizer make a difference in the price you pay? If so, explain how prices vary by month of purchase.
37. What type of financing arrangements do you use to purchases your fertilizer stocks?
    A. Personal resources ________ specify source of cash ___________
    B. Bank credit ________
        specify bank ______________
        specify interest rate (e.g., 12%/yr or 2%/mo, etc.) __________
        specify period of loan (total months) ___________
        specify total credit of this type received _____________
    C. Supplier credit ________
        specify interest rate (e.g., 12%/yr or 2%/mo., etc.) ___________
        specify period of loan (total months) ______________
        specify total credit of this type received _____________
    D. Other ________ details ___________________________

Zone__________________Wereda__________________Date____________

38. What were the biggest problems you encountered in getting your fertilizer supplies this year?
    A.
    B.
    C.
    D.

39. Is there anything that you can do differently next year to avoid these problems?
    A.
    B.
    C.

40. Is there anything that other actors in the fertilizer sector (importers, distributors, government) can do to reduce these problems?
    A.
    B.
    C.
    D.

41. Is there anything you could have done to reduce your purchase costs this year? (Larger order, cash payment, earlier repayment of credit, etc.)

42. What prevented you from doing these things?

We would now like to ask a few questions about your sales

43. Who are your principal clients (rank by volume of sales per group)
    A. Individual farmers purchasing for belg production
    B. Individual farmers purchasing for meher production
    C. Farmers associations or service cooperatives
    D. Other (specify)

44. Have you done anything special to encourage farmers to use more fertilizer? (circle one for each)
    A. Advertising
        1 - sometimes, 2 - often, 3 - never
    B. Repacking fertilizer into smaller bags than the standard
        1 - sometimes, 2 - often, 3 - never
    C. Using roving agents who go to villages
        1 - sometimes, 2 - often, 3 - never

D. Demonstration fields
   1 - sometimes, 2 - often, 3 - never

E. Price reductions
   1 - sometimes, 2 - often, 3 - never

F. Credit flexibility
   1 - sometimes, 2 - often, 3 - never

G. Offering advice on how to use products
   1 - sometimes, 2 - often, 3 - never

H. Other (specify)
   1 - sometimes, 2 - often, 3 - never

45. Has the volume of sales for your retail fertilizer business expanded, contracted or remained the same since you began your business?

46. If there has been a change, to what do you attribute it?

47. How is the sale price determined: (circle all that apply)
   A. Set by yourself based on what other dealers are charging
   B. Negotiated individually with each sale
   C. Other (specify)

48. How much have you sold this year in (specify unit: quintals or tons):
   A. cash __________________
   B. credit _________________
   C. in-kind payment at time of harvest _____________
   D. other (specify)_______________________________

49. Was there ever a period when clients wanted fertilizer and you had none in stock?

50. If yes, **when** did this occur and what was the **source of the problem**?

51. What were major problems that you encounter in your sales operation this year? (Don't repeat problems already mentioned thus far.)
   A.
   B.
   C.
   D.

INTERVIEWER NOTE: For each type of problem encountered provide detailed explanation of what happened and the impact on the business:
Possible problems: Unexpected costs, delays in delivery to clients, complaints about fertilizer quality, dissatisfied clients, delays in payments by clients, other
Possible impacts: Lower profits, reputation negatively affected, other.

52. What could you have done to avoid these problems next year?

53. What could other actors in fertilizer subsector do to diminish these problems?

Zone____________________Wereda____________________Date______________

Operating costs

Now we are going to ask some more specific questions about general operating costs and your ideas about how these could be reduced.

If you incur any of the following types of costs in running your fertilizer business please help us understand the magnitude of these costs:

Cost Category	Describe exact nature of cost	Estimated cost in birr (fill in at least one of two columns below):		Estimated time spent by you for this activity (days/yr)	Were this year's costs less, same, or more than last year's costs?	Could these costs be reduced if the volume of your purchases/ sales was greater? If yes, explain	Is there anything you can do to reduce these costs in the future? If yes, explain
		Total per year	Cost per unit (specify unit: qunital, ton, km, month, etc.)				
Licenses							
Taxes							
Storage space[99]							
Building maintenance							
Phone, fax, etc.							

[99] If storage space is rented, report total annual expenditure on rent during months in which fertilizer is stored. If storage space is owned, ask respondent for an estimate of how much income he could make by renting the storage space to others or how much it would cost him to rent a similar amount of space from others during the months that he stores fertilizer.

Zone__________________Wereda___________________Date____________

Cost Category	Describe exact nature of cost	Estimated cost in birr (fill in at least one of two columns below):		Estimated time spent by you for this activity (days/yr)	Were this year's costs less, same, or more than last year's costs?	Could these costs be reduced if the volume of your purchases/ sales was greater? If yes, explain	Is there anything you can do to reduce these costs in the future? If yes, explain
		Total per year	Cost per unit (specify unit: qunital, ton, km, month, etc.)				
Salaries and wages	Full time employees						
	Part time employees						
	Rebagging						
	Other (specify)						
Annual loss (report in qunital/ton)	during transport						
	during storage						
Transport	See separate transport pages						
Other							

NOTE: Go to transport cost questionnaires for (1) hired or (2) owned/operated vehicles.

Zone__________________Wereda___________________Date____________

Ethiopian Fertilizer Subsector Survey Questionnaire, July 1998
Transportation costs for fertilizer distributors other than SCs/FAs and salaried retailers/managers

This questionnaire is for all fertilizer market participants that are **hiring** transport for fertilizer purchases and/or sales.

Many reports we have read about fertilizer prices in Africa claim that one of the reasons for very high prices in Africa is that transportation costs are very high. For this reason, we would like to better understand all the elements that go into the transport costs that you pay for transporting fertilizer.

1. For all cases where you have paid for fertilizer transport please report the following details:

	origin	destina-tion	kms	Road condition 1. poor condition/dirt 2. good condition/dirt 3. poor condition/gravel 4. good condition/gravel 5. poor condition/paved 6. good condition/paved 7. other (specify)	total quantity (quintals)	trans-port cost (birr/ quintal/ km)	load-ing costs	off-loading costs	month
1									
2									
3									
4									
5									
6									

2. Would the transport costs listed above have been lower if: (yes/no)
   the fertilizer shipments were larger ___________
   the timing of the shipment was different _________
   the roads were better ___________
   other (specify) ___________________

Zone____________________Wereda_____________________Date______________

"We would now like to ask some details about what vehicles you own and costs of vehicle operation."

3. How many different types of transport do you own?

Type of transport	Capacity (kg, quintals or tons)
pick-up	
small truck	
big truck	
other	

Zone__________________Wereda__________________Date____________

Ethiopian Fertilizer Subsector Survey Questionnaire, July 1998
Transporters

This questionnaire is for all fertilizer market participants (importers, wholesalers, private retailers, etc.) and transporters who **OWN** their own vehicles.

II. "Thank-you for agreeing to participate in this survey. I need to begin by getting some general information about you and your firm."

QUESTIONS FOR TRANSPORT COMPANIES ONLY, ALL OTHERS GO TO PAGE 2.

1. Name of firm: ________________________
2. Respondent's position in firm: ________________________
3. How long in that position: ________________________
4. How long with firm: ________________________
5. Prior work experience before joining the firm: ________________________
6. How long has firm been transporting fertilizer in Ethiopia: ____________________
7. What was required of your firm to enter the transport business (amount of financial capital, contacts)? ________________________
8. Is the firm involved in transportation of other products? If so, what products: ________________________
9. Would you like to expand your fertilizer business? (transport more fertilizer?) ________________________
10. Could you take on more fertilizer transport contracts during the peak fertilizer period? ____________________
11. What are your busiest months during the year for transport of any commodities? ________________________(Ethiopian calender months)

QUESTIONS FOR ALL TRANSPORT OWNERS:

12. Do you consider your overall transport business (circle one)
    1. unprofitable
    2. slightly profitable
    3. very profitable

13. Has the profitability of your business increased, decreased, or remained the same since the beginning of your operations?

14. If there has been a change, to what do you attributed it?

Zone__________________Wereda__________________Date____________

15. Is transporting fertilizer (1) more (2) less (3) about the same level of profitability as transporting other products such as grains?
16. If fertilizer transport is more or less profitable than grain transport, explain why?
17. What could you do to increase the profitability of your transport activities?

II. "We would now like to get some cost details of transporting fertilizer on your most recent fertilizer shipment in which you transported fertilizer."

1. Route:
   origin: ___________________________
   destination: _________________

2. Kilometers traveled ______________
3. Quantity of shipment _____________ quintals
4. Month of travel _______________
5. Total cost of transport on this route _____________
6. Other charges associated with this shipment?
   loading? __________ birr/quintal
   off-loading? ____________ birr/quintal
   other? ______________________ (specify units)
7. Truck capacity ___________tonnes
8. What percent of the truck was filled with fertilizer? ___________ percent
9. Were other goods also transported at the same time as fertilizer? (yes/no) ________
   What products? _____________________________
10. Did you carry a return load? (yes/no) __________________ If yes, what product(s)? ____

11. If the amount of the fertilizer shipment was to double in size, would you offer a lower transport cost per quintal per kilometer? (yes/no) ___

12. If yes to 11., what would that lower rate be? ______________ (If they don't know the unit rate, ask for the total cost.)

13. Condition of road (circle the one that best applies)
    1. good condition dirt
    2. poor condition dirt
    3. good condition gravel
    4. poor condition gravel
    5. good condition paved
    6. poor condition paved
    7. other (specify) ____

Zone____________________Wereda_____________________Date_____________

We would now like to ask details of the cost you face in your transport business.
[The information required of transporters is to determine the largest component of their costs. To accomplish this, we can follow the list of costs below as a rough outline of a typical cost build-up for transporters.]

Zone___________________Wereda___________________Date_____________

IV. Transport cost build-up

1. Variable costs

"Please specify the following costs for two types of different size trucks (pick-up, truck, trailer) you may have"

Item	Vehicle type __________ tons ______			Vehicle type __________ tons ______		
	Costs [specify unit]	Comparison to last years costs [less, same, more]	Problems encountered	Costs [specify unit]	Comparison to 1997 costs [less, same, more]	Problems encountered
vehicle cost						
age at purchase						
estimated years of service after purchase						
duty paid/taxes at purchase						
salvage value						
financed (% of delivered cost)						
interest rate						
loan period (year)						
depreciation/year						
utilization km/year						
% of vehicle capacity used/km						

Zone__________________Wereda__________________Date____________

Item	Vehicle type _________ tons _____			Vehicle type _________ tons _____		
	Costs [specify unit]	Comparison to last years costs [less, same, more]	Problems encountered	Costs [specify unit]	Comparison to 1989 costs [less, same, more]	Problems encountered
insurance						
replacement tire cost (all tires)						
average tire life (km)						
fuel consumption (litre per 100 km)						
fuel cost per litre						
lubrication/oil/km or year						
estimated annual maintenance						

2. Miscellaneous overhead costs

Item	Quantity	Cost (specify unit)	Problems encountered	Suggestions for improvement in the efficiency of this operation
vehicle registration/license/taxes				
office space/garage (rent)	no. of offices ____ no. of garages ____			
utilities				
labor	no. of full-time ___/year			
	no. of part-time ___/week or per month			

APPENDIX 2

FINANCIAL IMPORT PARITY PRICE CALCULATION NOTES

Appendix 2 serves to provide more detail of the notes explaining the financial import parity price calculations for DAP and urea on page 180.

In 1998 shipments that were originally scheduled to arrive in Assab were rerouted when the Ethiopian-Eritrea conflict began in May 1998. All port transactions in Assab were paid in US dollars and calculated based upon a fixed exchange rate of US$ 7.20/Birr due to an agreement between the two governments at succession. In Djibouti the exchange rate used was the prevailing market rate in Addis. Bank charges were a fixed fee equal to 1.25 percent of the c.i.f. value for the service of transferring money from an Ethiopian bank to a foreign bank. Insurance is purchased either from an Ethiopian insurance company or a foreign insurer. Rates vary by insurers and also vary inversely with the total quantity insured.

Interest charged on the loan of the Ethiopian importer was added to the cost build-up. It was roughly 3 months between the time the loan was approved and the fertilizer arrived, thus there was an interest charge of 10.5 percent per annum on 100 percent of the c.i.f. value for 3 months. Additional interest payments occurred while the fertilizer is stored in Nazreth for 2 months before it was shipped to retail markets.

Once the ship was at the quay, a transit company managed the clearing operations of transferring the cargo from ship to truck and sending it on its way to Ethiopia. The transit company received the bulk of the payment, the port authority only received the port charges. In both Assab and Djibouti the port charge was US$ 1/MT. A transit charge was paid to a transit company (independent of the port authority) for handling cargo ex-quay until the cargo is loaded into a truck (typically a day later). A "transitor" traces discharged cargo, performs payment for loading cargo into a truck (by hiring port equipment like cranes, fork lifts and labor). Transit charges vary depending on how much fertilizer is stored at the port. In the past, some importers stored up to 40 percent of their shipment, but in 1998 typically 25 percent of a 25,000 MT shipment was left in storage due to the unavailability of transport. The transit charge was US$ 1.50/MT charged on the entire shipment and an additional US$ 7.20/MT charged on the portion left in storage at the port. In Djibouti a grace period of 45 days was permitted for stored fertilizer and in Assab, the limit was 30 days. Typically, fertilizer was removed from port storage within these periods.

Stevedoring refers to any charge related to unloading cargo from a ship to dock and is primarily a payment for labor services rendered. A minimum of 18 laborers are required around each of the 4 ship hatches for unloading. An additional 18 laborers are required for bagging and loading into trucks.

Crane charges are charged for use of cranes to off-load fertilizer. In Assab, a crane charge is charged regardless of whether ship or shore cranes are used. Crane charges were variable and exclusively charged (Kassahun 1998). In Djibouti ship cranes were usually used to transfer fertilizer directly from the ship into the funnel of the bagging machine that sits on the ground. Bagging was conducted immediately after fertilizer is off-loaded.

Typically three bagging machines were used on a shipment of 25,000 MT. A bagging machine usually runs 16 hours/day, a total of 18.75 bagging-days for a shipment of 25,000 MT. The rent for one machine was US$ 48/day, a total of US$ 900 for 25,000 MT (US$ 27.77/MT). Some companies such as EAL have their own bagging machines. A fee of US$ 4.25/MT was charged for use of own machines. Often before fertilizer is bagged, rent of excavators was required to mix up caked DAP (but not urea) on the ship.

In Assab, many of the port fees were fixed for stevedoring, bagging, etc., but in Djibouti many of the rates were more flexible and negotiated privately between two parties. Other costs in the cost build-up were also less transparent and may be a reflection of the relative efficiency of one company over another. For example, losses, administration and overhead, and margins must be estimated at an average although they will vary between suppliers. An estimated 0.5 percent of the c.i.f. price is calculated as losses for one company (Kassahun 1998). Administration and overhead also will vary considerably from importer to importer (US$ 0.15/MT is calculated for one relatively efficient company). A procurement margin of 2 Birr/quintal was added into the cost-build up. Fertilizer imports felt this margin was acceptable, a margin of 3-5 Birr/quintal was considered quite high in 1998 (GMRP 1998). The fertilizer subsector in Ethiopia is highly vertically integrated thus importers are also often engaged in wholesale and retail sales. A wholesale/retail margin of 2 Birr/quintal is added in addition to the 2 Birr/quintal importer margin.

Once fertilizer is bagged and loaded onto truck-trailers it is transported to the central storage warehouses in Nazreth. Only truck-trailers are used on the Assab or Djibouti routes, the capacity of which is between 22-40 tons, although 90 percent of the time, the capacity of the truck-trailers is 30 tons. There are no economies of scale present in inland transport, transport rates do not vary according to whether the truck-trailer is filled to capacity. The Djibouti-Nazreth in-land transport rate (0.057 Birr/MT/km) was higher than the Assab-Nazreth rate (0.044 Birr/MT/km) because Djibouti was a less efficient than the port of Assab. The turnaround time in Djibouti was longer for truck-trailers due to inefficient labor in coordinating and loading trucks (Kassahun 1998).

APPENDIX 3

PROFITABILITY SIMULATIONS FROM CHANGES IN FERTILIZER COST

Table 1. Financial Analysis by Technology Type and Labor Use

Budget Item	Tech 1 Local seed, no fert. **T1.0**	Technology 2 Local seed plus DAP **T2.1** lower[1]	 **T2.2** upper	Technology 3 Improved seed, DAP, and urea < recomm. **T3.1** lower	 **T3.2** upper	Technology 4 Improved seed, DAP and urea >= recomm. **T4.1** lower	 **T4.2** upper
n	4	21	22	28	28	25	25
1. Maize yield (kg/ha)	1835.00	2886.88	2921.77	4619.05	7060.26	5606.21	6237.74
1.a. Adjusted maize yield (kg/ha)[2]	1763.00	2829.72	2863.92	4527.59	6920.47	5495.21	6114.23
2. Farmgate price of maize (Birr/ha)[3]	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return	952.02	1528.05	1546.52	2444.90	3737.05	2967.41	3301.69
4. Total Variable Costs	705.90	682.85	1064.84	1235.16	1460.84	1500.77	1894.71
5. Total Package Costs[4]	49.00	249.59	349.44	534.20	562.48	710.50	730.49
5.a. Seed (Birr/ha)	49.00	33.14	44	107.6	113.08	142.97	147.04
5.b. DAP (Birr/ha)	0.00	216.45	303.74	219.35	230.23	291.85	299.41
DAP kg/ha	0.00	84.22	115.93	84.69	88.21	114.9	116.5
DAP Birr/kg	**0.00**	**2.57**	**2.62**	**2.59**	**2.61**	**2.54**	**2.57**
5.c. Urea (Birr/ha)	0.00	0.00	0.00	206.64	217.00	274.61	281.93
Urea kg/ha	0.00	0.00	0.00	84.69	88.21	114.90	116.50
Urea Birr/kg	**0.00**	**0.00**	**0.00**	**2.44**	**2.46**	**2.39**	**2.42**
5.d. Herbicide (Birr/ha)	0.00	0.00	0.00	0.00	0.00	1.07	0.00
5.e. Pesticide (Birr/ha)	0.00	0.00	0.00	0.61	0.00	0.00	0.00
5.f. Fungicide (Birr/ha)	0.00	0.00	1.70	0.00	2.18	0.00	2.11
6. Interest (Birr/ha)[5]	0.00	0.00	0.00	11.06	26.23	13.73	21.18
7. Labor (Birr/ha)[6]	387.00	240.50	532.58	448.11	468.95	458.22	830.31
7.a. Family & mutual labor (Birr/ha)[7]	351.00	217.22	484.43	396.18	371.43	418.55	770.49
7.a.i. Family & mutual labor days	78.00	48.27	107.65	88.04	82.54	93.01	171.22
7.b. Hired labor (Birr/ha)	36.00	23.28	48.15	51.93	97.52	39.67	59.82
8. Animal traction (Birr/ha)[8]	261.00	103.13	92.38	100.3	186.65	146.13	122.12
9. Hand tools and sacks (Birr/ha)	8.90	89.64	90.45	141.49	216.53	172.20	190.62
9.a. Tools (Birr/ha)[9]	3.10	3.03	2.80	2.92	4.72	4.01	3.49
9.b. Sacks (Birr/ha)[10]	5.80	86.61	87.65	138.57	211.81	168.19	187.13
Net Margin/Hectare (3.-4.)	246.12	845.20	481.67	1209.74	2276.21	1466.64	1406.97
Gross Margin/Hectare/Labor Day (3.-4.+7.a.)/7.a.i	7.66	22.01	8.97	18.24	32.08	20.27	12.72

Notes for Tables 1-4:

[1]Technology types were split into two: the 50% of farmers with the lowest yields and highest yields.

[2]Assumes no grain lost during shelling. Adjusted yield assumes maize harvested in November and storage losses of 1.98% per month until crop sale in January.

[3]Grain sold in January, immediately following harvest.

[4]MOA/SG2000 maize package consists of 25 kg/ha seed, 100 kg/ha DAP, 100 kg/ha urea.

[5]SG participants pay no interest; MOA program participants pay 10% interest annually for 10 mo.

[6]Valued at cash/in-kind payment rates provided by survey participants.

[7]Mutual labor = extended family members. Family/mutual labor valued at an ave. 4.5 Birr/day.

[8]Sum of rental costs reported by survey respondents: and for owned/borrowed oxen, maintenance plus depreciated value of animals and animal traction. Equipment multiplied by % of total farm represented by the MOA-SG, traditional or graduate plot.

[9]Depreciated value of 2 hoes, 2 axes, 2 cutting knives.

[10]Depreciated value of sacks needed to transport maize marketed in January. Since sacks are retained by farmers and used for other purposes, cost is apportioned by multiplying depreciated sack value by percentage of total farm represented by MOA-SG or graduate plot.

Table 2. Budgets by Labor Use – Scenario 6, reduced transport, 100% direct,, delivery 10% reduction in low-priced international f.o.b. price

Budget Item	Tech 1 Local seed, no fert.	Technology 2 Local seed plus DAP		Technology 3 Improved seed, DAP, and urea < recomm.		Technology 4 Improved seed, DAP and urea >= recomm.	
		lower[1]	upper	lower	upper	lower	upper
n	4	21	22	28	28	25	25
1. Maize yield (kg/ha)	1835.00	2886.88	2921.77	4619.05	7060.26	5606.21	6237.74
1.a. Adjusted maize yield (kg/ha)[2]	1763.00	2829.72	2863.92	4527.59	6920.47	5495.21	6114.23
2. Farmgate price of maize (Birr/ha)[3]	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return[3]	952.02	1528.05	1546.52	2444.90	3737.05	2967.41	3301.69
4. Total Variable Costs	705.90	657.58	1024.27	1125.91	1343.53	1364.04	1749.09
5. Total Package Costs[4]	49.00	224.32	308.86	424.95	445.17	573.77	584.86
5.a. Seed (Birr/ha)	49.00	33.14	44	107.6	113.08	142.97	147.04
5.b. DAP (Birr/ha)	0.00	191.18	263.16	192.25	200.24	260.82	264.46
DAP kg/ha	0.00	84.22	115.93	84.69	88.21	114.9	116.5
DAP Birr/kg	**0.00**	**2.27**	**2.27**	**2.27**	**2.27**	**2.27**	**2.27**
5.c. Urea (Birr/ha)	0.00	0.00	0.00	124.49	129.67	168.90	171.26
Urea kg/ha	0.00	0.00	0.00	84.69	88.21	114.90	116.50
Urea Birr/kg	**0.00**	**0.00**	**0.00**	**1.47**	**1.47**	**1.47**	**1.47**
5.d. Herbicide (Birr/ha)	0.00	0.00	0.00	0.00	0.00	1.07	0.00
5.e. Pesticide (Birr/ha)	0.00	0.00	0.00	0.61	0.00	0.00	0.00
5.f. Fungicide (Birr/ha)	0.00	0.00	1.70	0.00	2.18	0.00	2.11
6. Interest (Birr/ha)[5]	0.00	0.00	0.00	11.06	26.23	13.73	21.18
7. Labor (Birr/ha)[6]	387.00	240.50	532.58	448.11	468.95	458.22	830.31
7.a. Family, mutual labor (Birr/ha)[7]	351.00	217.22	484.43	396.18	371.43	418.55	770.49
7.a.i. Family & mutual labor days	78.00	48.27	107.65	88.04	82.54	93.01	171.22
7.b. Hired labor (Birr/ha)	36.00	23.28	48.15	51.93	97.52	39.67	59.82
8. Animal traction (Birr/ha)[8]	261.00	103.13	92.38	100.3	186.65	146.13	122.12
9. Hand tools and sacks (Birr/ha)	8.90	89.64	90.45	141.49	216.53	172.20	190.62
9.a. Tools (Birr/ha)[9]	3.10	3.03	2.80	2.92	4.72	4.01	3.49
9.b. Sacks (Birr/ha)[10]	5.80	86.61	87.65	138.57	211.81	168.19	187.13
Net Margin/Hectare (3.-4.)	246.12	870.46	522.25	1318.99	2393.53	1603.37	1552.60
Gross Margin/Hectare/Labor Day (3.-4.+7.a.)/7.a.i	7.66	22.53	9.35	19.48	33.50	21.74	13.57

Table 3. Budgets by Labor Use – Scenario 8, direct delivery from port to retail mkt., 100% direct delivery, 10% reduction in low-price international f.o.b. price

Budget Item	Tech 1 Local seed, no fert.	Technology 2 Local seed plus DAP		Technology 3 Improved seed, DAP, and urea · recomm.		Technology 4 Improved seed, DAP and urea ·= recomm.	
		lower[1]	upper	lower	upper	lower	upper
n	4	21	22	28	28	25	25
1. Maize yield (kg/ha)	1835.00	2886.88	2921.77	4619.05	7060.26	5606.21	6237.74
1.a. Adjusted maize yield (kg/ha)[2]	1763.00	2829.72	2863.92	4527.59	6920.47	5495.21	6114.23
2. Farmgate price of maize (Birr/ha)[3]	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return[3]	952.02	1528.05	1546.52	2444.90	3737.05	2967.41	3301.69
4. Total Variable Costs	705.90	652.95	1017.89	1122.10	1339.56	1358.87	1743.85
5. Total Package Costs[4]	49.00	219.69	302.48	421.14	441.20	568.60	579.62
5.a. Seed (Birr/ha)	49.00	33.14	44	107.6	113.08	142.97	147.04
5.b. DAP (Birr/ha)	0.00	186.55	256.78	187.59	195.39	254.50	258.05
DAP kg/ha	0.00	84.22	115.93	84.69	88.21	114.9	116.5
DAP Birr/kg	**0.00**	**2.215**	**2.215**	**2.215**	**2.215**	**2.215**	**2.215**
5.c. Urea (Birr/ha)	0.00	0.00	0.00	125.34	130.55	170.05	172.42
Urea kg/ha	0.00	0.00	0.00	84.69	88.21	114.90	116.50
Urea Birr/kg	**0.00**	**0.00**	**0.00**	**1.48**	**1.48**	**1.48**	**1.48**
5.d. Herbicide (Birr/ha)	0.00	0.00	0.00	0.00	0.00	1.07	0.00
5.e. Pesticide (Birr/ha)	0.00	0.00	0.00	0.61	0.00	0.00	0.00
5.f. Fungicide (Birr/ha)	0.00	0.00	1.70	0.00	2.18	0.00	2.11
6. Interest (Birr/ha)[5]	0.00	0.00	0.00	11.06	26.23	13.73	21.18
7. Labor (Birr/ha)[6]	387.00	240.50	532.58	448.11	468.95	458.22	830.31
7.a. Family, mutual labor (Birr/ha)[7]	351.00	217.22	484.43	396.18	371.43	418.55	770.49
7.a.i. Family & mutual labor days	78.00	48.27	107.65	88.04	82.54	93.01	171.22
7.b. Hired labor (Birr/ha)	36.00	23.28	48.15	51.93	97.52	39.67	59.82
8. Animal traction (Birr/ha)[8]	261.00	103.13	92.38	100.3	186.65	146.13	122.12
9. Hand tools and sacks (Birr/ha)	8.90	89.64	90.45	141.49	216.53	172.20	190.62
9.a. Tools (Birr/ha)[9]	3.10	3.03	2.80	2.92	4.72	4.01	3.49
9.b. Sacks (Birr/ha)[10]	5.80	86.61	87.65	138.57	211.81	168.19	187.13
Net Margin/Hectare (3.-4.)	246.12	875.10	528.63	1322.80	2397.50	1608.54	1557.84
Gross Margin/Hectare/Labor Day (3.-4.+7.a.)/7.a.i	7.66	22.63	9.41	19.52	33.55	21.79	13.60

Table 4. Budgets by Labor Use - Scenario 3, If fertilizer market is appointed by the regional govt. (hedonic model results)

Budget Item	Tech 1 Local seed, no fert.	Technology 2 Local seed plus DAP		Technology 3 Improved seed, DAP, and urea < recomm.		Technology 4 Improved seed, DAP and urea >= recomm.	
		lower[1]	upper	lower	upper	lower	upper
n	4	21	22	28	28	25	25
1. Maize yield (kg/ha)	1835.00	2886.88	2921.77	4619.05	7060.26	5606.21	6237.74
1.a. Adjusted maize yield (kg/ha)[2]	1763.00	2829.72	2863.92	4527.59	6920.47	5495.21	6114.23
2. Farmgate price of maize (Birr/ha)[3]	0.54	0.54	0.54	0.54	0.54	0.54	0.54
3. Return[3]	952.02	1528.05	1546.52	2444.90	3737.05	2967.41	3301.69
4. Total Variable Costs	705.90	691.27	1070.64	1259.72	1482.90	1545.58	1933.16
5. Total Package Costs[4]	49.00	258.01	355.23	558.76	584.54	755.31	768.93
5.a. Seed (Birr/ha)	49.00	33.14	44	107.6	113.08	142.97	147.04
5.b. DAP (Birr/ha)	0.00	224.87	309.53	226.12	235.52	306.78	311.06
DAP kg/ha	0.00	84.22	115.93	84.69	88.21	114.9	116.5
DAP Birr/kg	**0.00**	**2.67**	**2.67**	**2.67**	**2.67**	**2.67**	**2.67**
5.c. Urea (Birr/ha)	0.00	0.00	0.00	224.43	233.76	304.49	308.73
Urea kg/ha	0.00	0.00	0.00	84.69	88.21	114.90	116.50
Urea Birr/kg	**0.00**	**0.00**	**0.00**	**2.65**	**2.65**	**2.65**	**2.65**
5.d. Herbicide (Birr/ha)	0.00	0.00	0.00	0.00	0.00	1.07	0.00
5.e. Pesticide (Birr/ha)	0.00	0.00	0.00	0.61	0.00	0.00	0.00
5.f. Fungicide (Birr/ha)	0.00	0.00	1.70	0.00	2.18	0.00	2.11
6. Interest (Birr/ha)[5]	0.00	0.00	0.00	11.06	26.23	13.73	21.18
7. Labor (Birr/ha)[6]	387.00	240.50	532.58	448.11	468.95	458.22	830.31
7.a. Family, mutual labor (Birr/ha)[7]	351.00	217.22	484.43	396.18	371.43	418.55	770.49
7.a.i. Family & mutual labor days	78.00	48.27	107.65	88.04	82.54	93.01	171.22
7.b. Hired labor (Birr/ha)	36.00	23.28	48.15	51.93	97.52	39.67	59.82
8. Animal traction (Birr/ha)[8]	261.00	103.13	92.38	100.3	186.65	146.13	122.12
9. Hand tools and sacks (Birr/ha)	8.90	89.64	90.45	141.49	216.53	172.20	190.62
9.a. Tools (Birr/ha)[9]	3.10	3.03	2.80	2.92	4.72	4.01	3.49
9.b. Sacks (Birr/ha)[10]	5.80	86.61	87.65	138.57	211.81	168.19	187.13
Net Margin/Hectare (3.-4.)	246.12	836.78	475.88	1185.18	2254.15	1421.83	1368.53
Gross Margin/Hectare/Labor Day (3.-4.+7.a.)/7.a.i	7.66	21.84	8.92	17.96	31.81	19.79	12.49

APPENDIX 4

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