Grain Market Research Project

PROMOTING FERTILIZER USE IN ETHIOPIA:

THE IMPLICATIONS OF IMPROVING GRAIN MARKET PERFORMANCE, INPUT MARKET EFFICIENCY, AND FARM MANAGEMENT

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PROMOTING FERTILIZER USE IN ETHIOPIA: THE IMPLICATIONS OF IMPROVING GRAIN MARKET PERFORMANCE, INPUT MARKET EFFICIENCY, AND FARM MANAGEMENT

This report assesses how the recent deregulation of fertilizer prices will affect the profitability of fertilizer use on various crops throughout Ethiopia. The report also identifies other policy measures that can increase the cost-effective use of fertilizer to promote productivity growth throughout the food system. Results are based mainly on the derivation of value-cost ratios (VCRs) for the use of DAP fertilizer on selected crops in 51 cereal production areas of Ethiopia. The VCR is an indicator of profitability of fertilizer use, measuring the value of additional crop output relative to the cost of a given application of fertilizer. The factors that affect the VCR are the agronomic response of crop yields to the application of fertilizer, the cost of fertilizer to the farmer, and the price of the crop to which fertilizer is applied.

The information for this study came mainly from secondary sources and from field visits to selected production areas. In particular, the data on the response of yield (by crop type and by region) were obtained from the KUAWAB/DSA survey which was conducted in 1994. Producer output prices came from the Market Information System (MIS) of the Grain Market Research Project at the Ministry of Economic Development and Cooperation. The authors of this study also visited selected sites to collect information on fertilizer markets and reservation prices.

The paper is organized as follows: Section 1 presents background information on fertilizer use in Ethiopia. Section 2 reviews the profitability of fertilizer use, by crop and by region; Sections 3 and 4 estimate the impact of improving the performance of input and output markets respectively on fertilizer profitability; Section 5 addresses the effects of improving the response of fertilizer application; and Sections 6 and 7 deal with the integrated approach and conclusions, respectively.

1. BACKGROUND

Soil fertility has traditionally been maintained through long fallow periods in Ethiopia. Expanding population and food requirements, however, have led to a reduction or elimination of the fallow period and have pushed farmers in many areas onto more marginal lands. Agricultural practices over the years have resulted in a slow progressive process of soil erosion. The cumulative impact is this is now clearly evident. It is estimated that 50 percent of all cropland in Ethiopia faces soil degradation and erosion (Cambell 1991; Hurni 1988; Stahl 1990).

With more continuous cropping on the increase, organic material and nitrogen are rapidly depleted, and phosphorous and other nutrient reserves are being depleted slowly but steadily (Borlaug and Dowswell 1995). The fuelwood deficit is increasingly being made up by substituting dung and crop residues, thus leading to a drastic decline in the use of animal manures and residues for fertility improvement programs.

Although chemical fertilizers have been widely promoted, only 32.8 of the rural households in Ethiopia used fertilizers in 1995 (CSA 1996). Fertilizer sales increased from 105,000 tons in 1990/91 to 241,649 tons in 1995/96. This is equivalent to 10.8 kilograms of nutrient per hectare of arable land, compared to about 48 kg in Kenya and 60 kg in Zimbabwe (World Bank 1995). Application rates by most peasants are well below the recommended rates (200 kg per hectare according to the latest recommendation).

Agricultural production increased by less than 1% between 1980 and 1990. In the meantime, the rate of population growth averaged 3%, resulting in a widening gap between food supply and demand. The rate of food self-sufficiency declined to 58% in 1991/92.[1] Per capita availability of food declined well below the recommended intake of 2,100 calories per day. In recent years, agricultural production has increased owing to a more favorable policy environment, increased use of fertilizers, and good weather.[2] But past experience show that good harvest for one or two years can be accompanied by bad years.[3] The threat to agricultural production emanating from drought is still considerable.

Measures to increase agricultural production in Ethiopia may be based on expanding cultivated area and/or agricultural intensification. But much of the highland suitable for cropping with the present techniques and cropping patterns has already been used. The opening up of new land should help reduce population pressure in the highlands and pave the way for gainful employment in agriculture. However, the prospect of cropped area expansion

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[1] World Food Program, Cereals, Pulses and Oilseeds Balance Sheet Analysis for Ethiopia, 1993.

[2] The level of food grain production in 1995/96, for instance, is regarded as one of the highest ever. An estimated 19% increase in area planted to food crops, a 16% increase in productivity resulted in a 40% increase in output was reported (see for instance, CSA, Agricultural Sample Survey 1995/96, Bulletin No. 152).

[3] For instance, the bumper harvest in 1982/83 was followed (2 years later) by one of the worst famine in the history of the country (1984/85). See also Table 1.

is mostly confined to the sparsely populated and fragile areas of the western and southeastern highlands and their associated valleys.

Increasing crop productivity is the only realistic option of improving food availability in Ethiopia. At present, cereal yields are among the lowest in the world. The average yield of teff, barley, wheat, maize and sorghum is 8, 11, 12, 16, and 14 quintals per hectare, respectively. The results of the SG 2000 project, half-hectare extension management plots (EMTPs), have shown that grain yields for maize, wheat and teff can be increased to 55 qt/ha, 31 qt/ha and 18 qt/ha, respectively. The yield levels from the demonstrations represent 200 - 300 percent increase over the national averages.[4]

There may be several ways of achieving enhanced agricultural productivity. These include widespread use of improved cultural practices, greater and more efficient use of organic fertilizers, expanded use of irrigation, minimizing post-harvest losses, more efficient pest management techniques and widespread use of chemical fertilizers and improved seeds. These methods are mutually reinforcing and all may need to be introduced for better results. However, it is not possible to expect significant contributions from some of these options at least in the next few years. For instance, more time and investment is required to significantly increase productivity by way of irrigation.

A more plausible alternative to bridge the wide food gap (at least in the immediate future) in Ethiopia would be to effectively promote efficient and sustainable use of chemical fertilizers. Compared to organic wastes or manure, commercial fertilizers are relatively more concentrated (contain more nutrient per unit), making them cheaper to transport and store. More importantly, there are simply not enough organic fertilizers to get the productivity increases needed. Farmers need to adopt improved cultural practices that combine available organic matter with chemical fertilizers.

Under farmers' conditions, 100 kg of DAP (46% kg P_2O_5 and 18 kg N) is estimated to yield an additional 3.40 to 7.44 quintals of cereal output.[5] It is estimated that of the total 1995/96 meher (main season) cereal output (8.27 million tons), some 12.9 percent or 1.07 million tons is attributable to the use of fertilizers (Table 1). This is roughly 50 percent of the total cereal marketed in 1995/96.[6]

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[4] The centerpiece of the SG 2000 is farmers' half-hectare demonstration plots, utilizing improved seeds, improved management practices, and fertilizer types and rates as recommended by the National Fertilizer Input Unit of the Ministry of Agriculture.

[5] See Table 1.

[6] Based on the Food Security Survey, the proportion of the total marketed cereal is 26.2 percent.

Table 1. Incremental Yield Obtained as a Result of Fertilizer Use in 1995/96 Compared to Not Using Fertilizer At All

Crop	(A) %of total fertilizer (2,416,490Qt) applied to each crop (1995/96)	(B) Fertilizer used on each crop (1995/96) (Qts)	(C) Incremental Yield by using 100kg DAP/ha Qt/ Ha	(D)=(B)*(C) Incremental yld as a result of fertilizer use (Qts)
Teff	46.3	1,118,834	3.49	3,904,733
Wheat	21.7	524,378	6.13	3,214,439
Maize	10.7	258,564	7.44	1,923,719
Barley	7.5	181,236	6.75	1,223,348
Millet	2.9	70,078	4.44	311,147
Sorghum	1.78	43,013	3.4	146,245
Total	90.88	2,196,106		10,723,633

Note:
Total fertilizer supply for the 95/96 crop year =406,565 ton
The amount unutilized in 1995/96 crop year = 164,916 ton out of which 54330 ton for AISCO, 91689 ton for Amalgamate Eth. Ltd and 18897 ton for Ambassel Trading Co.
The amount utilized in 1995/96 = 241649 ton.
The total marketd quantity of cereals in 1995/96 = 21.65 Million quintals (ie, 26.18 % of the total cereal produced)
The total quantity of cereals produced in the 1995/96 Meher season = 82.7 Million quintals.

A = Percentage proportion of fertilizer applied on each crop obtained from CSA, Agricultural Sample Survey, Statistical Bulletin # 152.
B= proportion of fertilizer applied on each crop as a product of percentage share "A" and the total quantity of fertilizer utilized, ie 2496640 Qts.
C= Incremental yield as a result of using 100 kg of DAP/ha (under farmers' management) obtained from KUAWAB/DSA, Fertilizer Marketing Survey; USAID/Ethiopia, October 1995. The figures were obtained through a group discussion which asked each group to estimate the incremental yield from the use of 100 kg of DAP. The focussed discussion covered 51 sites (see Table 4) drawn from Tigray, Amhara, Oromiya and Souther Region.

D= The incremental yield resulting from use of fertilizer

Drawing on the lessons of SG 2000, the Government formulated a new agricultural extension program (NAEP), known as Participatory Demonstration and Training Extension System (PADETES), in 1994/95. The new package as currently defined entails the use of 100 kg DAP(46 kg P_2O_5 and 18 kg N) and 100 kg urea (46 kg N) per hectare (recommendation rates for sorghum and barley are somewhat lower), improved seeds, chemicals (herbicides and chemicals) and improved management practices. During the 1995/96 production season, about 350,000 farmers were covered by the PADETES, a 10 fold increase over the previous (initial) year.

Up until 1992, the distribution and marketing of fertilizer was fully under state control. Fertilizer import and distribution was handled by the state-owned Agricultural Inputs Supply Corporation/Enterprise (AISCO). The task of clearing customs and forwarding to the six transit warehouses (located in different parts of the country)[7] rested with the monopolistic parastatal named Maritime and Transit Services Corporation (MTSC). Another parastatal, the Ethiopian Freight Transport Corporation (EFTC) was responsible transporting fertilizer to the transit warehouses of AISCO. Fertilizer was then transported to about 600 storage facilities (marketing centers) of the Ministry of Agriculture. The handling and selling (to farmers) activities, including keeping proper records of stock and submitting sales document to AISCO, were performed by the MOA staff. The whole system was characterized by a complete absence of competition or efficient distribution. Shortages and delays were the hallmark of the fertilizer distribution system under the former government. Fertilizer was rationed in many high potential areas and many farmers in other areas had no access to the input. More importantly, the bureaucratic distribution combined with the fixed output price and grain delivery quota (imposed on each farmer) made the use of fertilizer unattractive.

Consistent with the new economic policy, the Government (TGE) designed the new Marketing System (NMS) for fertilizer in 1992 with the main objective of liberalizing the fertilizer market and creating a multi-channel distribution system. The liberalization permitted the private sector to engage in the importation and distribution of fertilizer, hence ending the monopoly power of the state-owned Agricultural Inputs Supply Corporation (AISCO).[8] In 1994, the Council of Ministers issued regulations (Regulations No. 177/1994) to restructure and streamline AISCO along the Public Enterprise Proclamation No. 25/1992 which entails internal restructuring for a competitive operation.

Since the introduction of NMS, AISCO has transferred some of its distribution network to the private sector. It has appointed private distributors, wholesalers, and retailers which operate through principal-agent arrangements. Private sector involvement began with the importation of 25,000 tons of DAP by the Ethiopian Amalgamated Pvt Limited (EAL) in 1993. This amounted to 18.5% of the total import. EAL imported 105, 669 tons in 1996. Three years after EAL moved into the fertilizer market (1996), Ambassel Trading Enterprise imported 24,337 tons. AISCO imported 219,574 tons in the same year.

The National Fertilizer Policy, introduced in 1994, calls for the gradual elimination of fertilizer subsidies and the current system of pan-territorial pricing, the expansion of the private sector's role in the fertilizer trade, and the establishment of the National Fertilizer Industry Agency (NFIA). According to the Policy, NFIA will be the major instrument for the fertilizer sector. NFIA's major responsibilities include: (I) ensuring efficient implementation of the National Fertilizer Policy by setting up adequate monitoring, review and coordinating mechanism; (ii) institutional and human resource capacity building; (iii) donor coordination and finally through these actions (iv) contribute significantly to increasing agricultural productivity and building indigenous (organic and inorganic) fertilizer production capability.

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[7] These were Addis Ababa, Mojo, Nazereth, Assela, Jimma and Kombolcha.

[8] AISCO was established in 1985. Between 1978 and 1984, the Agricultural Marketing Corporation (AMC), State-owned parastatal, was the sole importer and distributor of fertilizers.

Despite the aggressive promotion of fertilizer use by the Government through its NAEP and a significant increase in the amount of credit allocated for the purchase of fertilizer by farmers[9], national fertilizer consumption has lagged well behind annual targets of the Government. For instance, of the total 406,565 tons of fertilizer (DAP and urea) made available through government and private distribution channels in 1995/96, only 241,649 tons or 59.4 percent was actually sold (Table 2). Carryover stock amounted to 164,916 tons. The output foregone due to the unutilized fertilizer is estimated at 0.73 million tons of cereal (8.8% of the meher cereal output or 33.8 % of the total cereal marketed) (Table 3).

Table 2. Fertilizer Sales (Up to August 31st) Vs. Availability in 1996 (MT)

Type	Available	Sales	%
DAP	311,005	200,251	64.40
UREA	95,506	41,398	43.30
Total	406,565	241,649	59.40

Source: NFIA documents, 1996

9 During the 1996 crop season, a total of 522.7 million Birr was granted (by the Commercial Bank of Ethiopia and the Development Bank of Ethiopia) in the form of agricultural inputs credit to regional states. The amount represented about 92 percent increase over the previous year (272.9 million Birr). See for instance, Itana Ayana, Agricultural Inputs Credit Performance since 1994, and Plans for 1997, (paper presented at the National Fertilizer Workshop, 15 - 18 October 1996).

Table 3. Forgone Cereal Production as a Result of Not Utilizing the Available Fertilizer

Crop	(A) % of unutilized fertilizer (1,649,160 Qt) applied to each crop (1995/96)	(B) Quantity of unutilized fert. that could be applied to each crop (Qts)	(c.) Incremental Yield by using 100kgDAP/ha Qt/ Ha	(D)=(B)*(C) Incremental production from using the available but unutilized imported fertilizer (Qts)
Teff	46.3	763,561	3.49	2,664,828
Wheat	21.7	357,867	6.13	2,193,729
Maize	10.7	176,460	7.44	1,312,863
Barley	7.5	123,687	6.75	834,887
Millet	2.9	47,825	4.44	212,345
Sorghum	1.78	29,355	3.4	99,807
Total	90.88	1,498,756		7,318,460

Note:

A= percentage proportion of fertilizer applied on each crop obtained from CSA Agricultural Sample Survey Statistical Bulletin # 152.

B= Unutilized fertilizer quantity of 1649190 Qts obtained from NFIA record, 1996. The share of unutilized fertilizer for each crop calculated by multiplying "A" by the unutilized amount ,ie, 1649160. The difference between the this and the sum of "D " is the share of other crops like pulses oilseeds and permanent crops

C= Incremental yield as a result of using 100 kg of DAP/ha (under farmers' management) obtained from KUAWAB/DSA " Fertilizer Marketing Survey; USAID/Ethiopia, October 1995.

D= Incremental yield that would have been obtained if all the available fertilizer was utilized calculated asa product of column "B" and "C"

The total marketd quantity of cereals in 1995/96 = 21.65 Million quintals (ie, 26.18 % of the total cereal produced)

2. THE PROFITABILITY OF FERTILIZER USE

2.1. Factors Influencing Fertilizer Use

The decision to adopt fertilizer is determined by a number of factors. These mainly include: (1) the response rate of fertilizer application (increase in output from a given increase in fertilizer use); (2) the cost of fertilizer at the farm gate (including the transaction costs associated with obtaining it); and (3) the crop output price. The response rate itself depends on farmers and use of complementary inputs. The cost of fertilizer is affected by supply conditions, infrastructure, credit availability, transaction costs associated with obtaining fertilizer (and credit), and the extent of risk and uncertainty. Similarly, grain prices are conditioned by infrastructural development, market structure, and supply and demand conditions.

High input and marketing costs have the effect of raising the price of fertilizer and lowering grain prices. These costs are highest in situations where the fertilizer marketing system is not well coordinated or integrated with the grain marketing system. Marketing facilities such as trucks, stores and labor are generally underutilized if input and output markets are handled separately by independent operators. The systematic integration of commodity and fertilizer marketing would facilitate fuller utilization of the facilities and lead to a reduction in marketing costs, stabilize prices and enhance the timely provision of fertilizers to farmers. In this regard, the removal of the constraints to free, open and competitive markets plays an important role in improving the incentive to use fertilizers. In addition to the coordination of input/output/credit markets, the use of fertilizer can be made cost effective by improving the agronomic efficiency of fertilizer use (e.g. Dembele, 1996; Staatz, 1989; FAO, 1985).

2.2. Measuring the Profitability of Fertilizer Use

There are different ways of measuring the profitability of fertilizers. Some of the most commonly used methods are the value-cost ratio (VCR), partial budget analysis[10] and the ratio of crop price to fertilizer price.[11] Results of this study are based mainly on the derivation of value-cost ratios (VCRs) for the use of DAP fertilizer on selected crops in 51 cereal production areas of Ethiopia. The VCR is an indicator of profitability of fertilizer use, measuring the value of additional crop output relative to the cost of a given application of fertilizer. In addition, an attempt is made to estimate farmers' reservation price of fertilizer.[12]

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[10] The partial budget analysis refers to net benefit obtained (per unit area) after deducting all variable costs from gross benefits calculated by multiplying yield with producer price.

[11] The ratio of crop price to fertilizer price measures how much kg of grain is needed to buy 1 kg of fertilizer.

[12] Reservation price of fertilizer is defined as the maximum price above which the farmer refuses to buy the input.

(a) The value-cost ratio (VCR)

The most commonly used guideline for the profitability of fertilizer use is the value/cost ratio (VCR). This ratio is defined as follows:

$$\text{VCR} = \frac{\text{Incremental crop output due to fertilizers} \times \text{Unit value of crop output}}{\text{Cost of fertilizer}}$$

In the absence of risk and transaction costs of acquiring fertilizer and selling output, a producer may be expected to operate up to the point at which the VCR = 1, i.e., marginal cost of the input equals its marginal revenue. However, because of risk and transaction costs a VCR greater than 1 is needed to induce farmers to buy fertilizers. In situations where production risks are considerable and market failures are prevalent, farmers may not adopt fertilizer unless the VCR is sufficiently high. The use of fertilizer may also result extra labor costs in the form of additional weeding, harvesting, threshing, interest, etc., and in non-monetary transaction costs associated with procuring credit and/or fertilizer. Because of these additional costs, a VCR greater than 2 is often regarded as the critical threshold to make fertilizer profitable and convince farmers to use fertilizer (Heisey and Mwangi, 1996).[13]

The VCR highlights the fact that it is both expected revenue as well as input cost that determines the viability of fertilizer use. Expected revenue is not only related to the output price, but also the quantity sold. It is commonly felt that incentives to use fertilizer on grain crops may be depressed by low grain prices. However, if low grain prices occur as a result of favorable production, and farmers have more to sell than ordinarily, then the resulting revenue from crop sales may actually increase, and improve their ability to finance input purchases in the next season. In other words, low grain prices can be more than offset by increased output response due to good weather. Hence, fertilizer use may remain profitable or the VCR may not be adversely affected by low grain prices.

Many households in Ethiopia are net buyers of grain. In the 1995/96 season, it is estimated that 37.3 percent of farmers sold no grain of any kind between October 1995 and June 1996. Over this 9-month period, 48.2% of the rural households in Ethiopia were net buyers of food, i.e., they purchased a greater amount of grain than they sold. These survey results are based on a nationally-representative sample of 4,338 rural households, implemented by the MEDAC Grain Market Research Project with the assistance of Central Statistical Authority. Even though the 1995/96 season was a good production year, 20% of the rural households in Ethiopia purchased an average of 4.5 quintals though June, with more purchases anticipated during the hungry season July-September. Even though the exact characteristics of these households are not yet known with certainty; the vast majority of them are likely to cultivate marginal lands and/or own very small holdings (over 20% of the holdings in Ethiopia are less

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[13] It should be noted that the VCR, unlike partial budget, does not seek to quantify the actual costs of using fertilizer. It only establishes a margin between the value of incremental output and fertilizer cost and assumes that other costs and risk premium are less than this margin. Moreover, it is not possible to compare ratios to assess relative profitability of two fertilizer levels

than 0.5 ha). At any rate, the ability of these net food- purchasing households to buy fertilizer is negatively affected as grain prices rise. The higher the price of grain, the more of their scarce income must be spent on procuring grain for household consumption, leaving less money to purchase inputs. For most smallholder farmers, the ability to finance purchase of inputs is most severely constrained during a drought year. Even though output prices are high, most households have little or no crops to sell, leaving them with little revenue to afford inputs.

For many farmers, farm and off-farm revenue is a more important determinant of farmers' ability to purchase fertilizer than crop prices. The cost of fertilizer is often financed through the sale of animals, cash crops such as oilseeds and coffee (in coffee-growing areas), forest products, etc. Farmers with no alternative source of cash income may rent part of their holdings to raise money for purchasing fertilizer.[14]

The VCR of selected sites[15] is shown on Table 4 (See Annex I for more details). Both the subsidized price of 200 Birr per quintal of DAP (1996 actual conditions) and the unsubsidized price of 256.9 Birr (1996 unsubsidized scenario) were used in calculating the VCR.[16] For the 51 areas examined, the estimated VCR exceeded 2.0 in 40 cases (78%) under the 1996 actual (subsidized) conditions and exceeds 2.0 in 26 cases (51%) under the unsubsidized scenario. The mean VCR for maize, wheat and teff was 2.31, 3.47 and 2.69, respectively, under the 1996 actual (subsidized) conditions. The mean VCR drops to 1.80, 2.7 and 2.09 respectively under the unsubsidized scenario. The mean VCR dropped from 2.71 to 2.11.

For the 13 maize growing areas, the VCR estimates which were below 2 for only 3 cases (23.1%) under the 1996 conditions increased to 8 cases (61.5%) under the unsubsidized rates. For the 25 areas in which teff is the most important crop, VCR estimates below 2.0 were obtained in 6 (24%) and 13 (52%) areas under the subsidized and unsubsidized prices, respectively. For the 8 wheat producing areas, no area had VCR estimates below 2 under the subsidized fertilizer price scenario, and had only 2 (25%) under the unsubsidized price scenario. Even with the subsidies, the VCR estimates were below 2 in 10 areas (19.6%). If fertilizer prices were not subsidized, the VCR estimates would have fallen below 2 for an additional 15 areas (29.4%). The VCR remained above 2 in the case of 26 sites which are

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[14] According to a focus group discussion held with farmers in East Shoa, Arsi and North Shoa, farmers with little or no cash income often rent part of their land and buy fertilizer with the proceeds for the remaining plot. When a farmer is short of cash and when other sources of income are lacking to pay for fertilizer purchase, renting out part of the family landholding often becomes necessary.

[15] These sites are from KUAWAB/DSA (1995) survey which covered the main fertilizer-using regions of Oromia, Amhara, Southern and Tigray. Members of the focus group which estimated the incremental yield were from a cross- section of the community. On average 10 to 12 farmers took part in each group discussion. The group was requested to reach consensus on the average response for an average year. See annex 4 for more details.

[16] Output prices are obtained by taking the average January-to-June 1996 producer prices prevailing in the respective areas (MEDAC/EGTE Grain Marketing Research Project, Market Information System, 1996). Grain prices have generally tended to decline over this period because of the bumper harvest.

chiefly wheat and teff growing areas in Arsi and East Shoa zones, respectively, and a few maize and barley growing areas in the Southern regions (S.N.N.P.R).

The discussion above clearly demonstrates that not all farmers attain a VCR greater than 2. The ratio is less than the critical threshold of 2 for a good proportion of the study areas or farmers even when fertilizer is subsidized. Perhaps fertilizer is absolutely essential to produce subsistence crops, hence profitability may not be of serious concern. It may also be that the opportunity cost of grain is very high for such farmers, especially for those that are net buyers of grain. Grain output is valued at a price higher than the farm-gate price by some farmers, thus making fertilizer profitable.

Table 4. Summary of Value-Cost Ratio (VCR) Estimates for DAP Fertilizer Use At Prevailing (Subsidized and Pan-Territorial) Fertilizer Prices, By Crop

Crops	Number Of Sites	VCR 96 Subsidized			VCR 96 Unsubsidized		
		Range	Mean	No. (%) of sites with VCR > 2	Range	Mean	No (%) of sites with VCR > 2
Teff	25	0.50 - 4.36	2.69	19 (76)	0.39-3.40	2.09	12 (48)
Maize	13	0.83 - 3.69	2.31	9 (69)	0.65-2.88	1.80	4 (31)
Wheat	8	2.01-5.43	3.47	8 (100)	1.56-4.23	2.70	6 (75)
Barley	3	2.07-3.59	2.83	3 (100)	1.61-2.80	2.20	2 (67)
Millet	2	1.53-3.16	2.35	1 (50)	1.19-2.46	1.83	1 (50)

(b) The reservation price of fertilizer

In order to gauge the attitude of farmers to fertilizer prices, about 100 respondents (drawn from selected high potential areas in Etaya (Arsi), Shashemene (East Shoa), Alaba (Kembata, Alaba and Tembaro zone), Hossana (Hadiya zone), Welkitte (Guraghe zone) and Becho (West Shoa) were asked about the fertilizer price at which they will stop buying the input (reservation price). The results, as summarized in Table 5a to 5b, indicate that the mean reservation price is 245 Birr/qt. However, the price varies markedly from one group of farmers to another: between 100 and 175 Birr/qt for 26 percent, 200 to 250 Birr/qt for 36 percent, 275 to 325 Birr/qt for 20 percent, and 350 to 400 Birr/qt for 18% (Table 5b). For 26 farmers (26%), the reservation price is lower than the 1996 subsidized price (200 Birr/qt). The reservation price was greater or equal to the 1996 unsubsidized price (approximately 250 Birr) for 46 farmers.

It should be noted that the reservation price varies by the type of the major crop grown. The mean price for wheat and teff growing areas was 245 and 218 Birr/qt, respectively (Table 5b). This is also consistent with the VCR values shown on Table 4 (higher for wheat than for teff). Variations by region are also considerable: relatively higher for Kembata (300 Birr/qt), East

Shoa (276 Birr/qt) and Arsi (263 Birr/qt), perhaps reflecting the absence of alternative soil fertility restoring techniques more than anything else. This observation is also consistent[17] with the findings of a survey which indicated that in some areas fertilizer may be viewed as an indispensable commodity without which little or no output is obtained (KUAWAB/DSA, 1995). The survey reported that some farmers feel compelled to buy fertilizer at virtually any fertilizer price/output price ratio. In response to how they responded if faced with unexpected price increases and shortage of cash to procure planned amounts, about 32.5 percent of the user farmers indicated that they would somehow raise more money to buy the required amount. Such farmers believe that there is little or no output without fertilizers, hence they would not reduce their purchase in the event of prices that are higher than expected. The relative size of such farms is also higher than the average (over 50% higher) in the major fertilizer consuming areas such as Arsi, East Shoa, Gurage and Hadiya. There may be no alternative to using fertilizer in these densely populated and intensively cultivated areas where traditional soil fertility restoring techniques such as fallowing cannot be practiced. The opportunity cost of fertilizer may thus be very high. As pointed out by some farmers, it is possible that many households may go hungry without fertilizer.[18]

Table 5a. Distribution of Reservation Prices

Reservation Price (Birr)	Frequency	Percent	Cumulative Percent
100	4	4	4
125	1	1	5.1
140	1	1	6.1
150	9	9	15.2
175	11	11	26.3
200	19	19	45.5
220	1	1	46.5
225	7	7	53.5
250	9	9	62.6
275	9	9	71.7
300	10	10	81.8
325	1	1	82.8
350	3	3	85.9
400	14	14	100
NO	1	1	
Total	100	100	100

[17] The only exception is Guraghe which has the lowest reservation price, contrary to the finding that most farmers in the area reported to have intentions of buying fertilizer at any price. The discrepancy may be attributed to the small sample size.

[18] By contrast, about 45.7 percent of the respondents indicated that they will buy as much as the money on hand permits while 10.7 percent took the position that they will stop buying altogether.

Table 5b. Mean Reservation Price by Crop Type, Zone and Size of Holding by Crop Type

Crop type	Mean Reservation Price (Birr)	Standard Deviation	Cases
Teff	218.055	73.34	36
Maize	285.29	106.09	1
Wheat	244.7	68.11	33
Barley	223.33	50.08	2
Sorghum	171.67	30.14	3
Chick peas	300	-	1
Cow Peas	187.5	17.67	3
Durrah	400	-	3
Potato	400	0	17
Total	244.8	84.57	99

Table 5c. Reservation Price by Zone

Zone	Mean reserv.Price (Birr)	Standard Deviation	Cases
W. Shoa	198.21	46.47	14
Hadiya	183.18	52.31	11
E.Shoa	276.29	84.75	35
Arsi	263.16	53.59	19
Kembata	300	113.65	10
Gurage	177.5	70.2	10
Total	244.8	84.57	99

Table 5d. Reservation Price by Size of Land Holding

Size of Holding (Ha)	Mean Reservation Price (Birr)	Standard Deviation	Cases
0.5	240	125.7	6
0.75	200	35.35	2
1	240.8	91.29	25
1.25	268.75	94.37	4
1.5	246.15	61.1	13
1.75	175		1
2	239.7	91	17
2.25	400		1
2.5	250	74.7	14
3	235	102.19	10
3.5	200		1
4	262.5	53.03	2
6	287.5	17.67	2
10	300		

3. THE EFFECTS OF IMPROVING THE FERTILIZER MARKET

3.1. Implications for Fertilizer Prices

There are a number of indications which suggest that the existing practice of procurement has resulted in high import costs of fertilizer.[19] First, the procurement is not planned to coincide with seasons of low prices but made as and when the foreign exchange is made available. Importers have no entrepreneurial opportunity of choosing their time of purchase. For instance, importers started procurement orders in December 1995 for the current season. But December-February is the period during which world market prices are at their highest (based on the average monthly prices over the period 1992-95). Lowest prices are typically obtained in June-July. The difference between the average inflation-adjusted price in January (high) and July (low) was US$ 22 for DAP-Morocco bulk, US$ 11 for DAP-Jordan bulk, US$ 17 for Urea, Eastern Europe and US$ 17 per ton for Urea, Middle East (Table 6).[20] Obviously, the savings from advance purchase should be balanced against the higher interest payment and storage costs. But it is argued that the gain from a well-planned procurement can be substantial. Under the existing practice, importers buy fertilizer when world prices are high, resulting in higher prices for farmers.

The procedures used by the NFIA for allocating foreign exchange are lengthy and bureaucratic. According to KUAWAB/DSA (1995), the total time requested to procure and import fertilizer varies from 135 to 365 days depending on the specific sources of funds. It may take 30 to 136 days for donors to approve funds. Floating of tenders to meet donors' specific source/origin and other procurement regulations requires an additional 30 to 90 days, again depending on the donor, preparation, evaluation and approval of bid documents, bank procedures and shipment may take 75 to 109 days.

Second the dispersement of the foreign exchange, provided by the different international donors is tied to various conditions.[21] Donors often apply rigid regulations on how and by whom their fund can be used to import fertilizer. Fertilizer is often not imported from the least expensive sources.

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[19] This section draws heavily from the previous study which focused on the performance of fertilizer procurement and distribution (Mulat, Ali and Jayne, 1996)

[20] The fluctuation in world price is partly related to the entry and exit of the big importers such as China and India.

[21] Under current practice, importers are allocated foreign exchange by the NFIA and then follow the procedures imposed by donors.

Table 6. Average Monthly Deflated Prices of DAP and Urea, f.o.b., Selected Countries (1991-96) US $/Ton

	DAP, Morocco (Bulk)	DAP, Jordan (Bulk)	Urea, East Europe	Urea, Middle East
January	203	201	143	162
Feberary	201	207	144	162
March	189	196	135	151
April	186	194	131	149
May	185	192	127	143
June	183	191	126	144
July	181	190	126	145
August	183	192	129	148
September	187	189	131	148
October	192	192	134	153
November	193	196	138	157
December	201	201	145	161

Source: Fertilizer Marketing Bulletin, FMB Consultants Ltd., Middlesex, England, various issue

Third, the current practice of importing in lots of 25,000 tons or less has significantly increased the cost of procurement and shipment. According to AISCO, the number of bidders participating in any tender is small and often two suppliers are the only winners: Norsk Hydro and Jordan Phosphate Mining Corporation (JPMC). Many suppliers have not been attracted perhaps because of the smaller quantity carried by each tender (maximum of 25,000 tons).

Fourth, the use of liner terms for shipment has resulted in higher CIF prices than free-out or charter terms because demurrage costs are borne by the suppliers or shipping agency. Liner terms have no cost advantage when the Assab port is less congested nowadays (since the number of relief cargoes arriving at Assab has declined sharply. A report by the World Bank has also indicated that a significant saving in ocean freight can be achieved by change over to CIF charter terms (World Bank, 1995).

Finally, costs can be reduced by switching over to bigger vessels and inducing competition between the two ports - Assab and Djibouti. Instead of a 25,000 tons ships, bigger ships of

40,000 tons or more can be used to reduce freight costs.[22] This arrangement is particularly useful to cope with the rapidly growth fertilizer consumption in the country.

Like the procurement, the wholesale and retail operations are not as efficient as one might expect. The market is largely shared between AISCO, accounting for 68.2%[23] of the total fertilizer made available for sale in 1996, and EAL with a share of 31.8% in the same year. The two firms seem to rely on unfair sales practices, instead of competing freely in the market. For instance, AISCO alleges that the Ethiopian Amalgamated Pvt. Limited (EAL) bribed local authorities in high potential areas to facilitate the sale of its fertilizer. On the other hand, EAL maintains that local authorities intervene in the market in favor of the parastatal AISCO and its agents. The company attributes its poor sales performance in 1996 (EAL sold only 29.2% of what it supplied) to the restrictions on private fertilizer distribution imposed by the authorities. By contrast, AISCO was able to sell 78% of its supply.

In order to lower the cost of fertilizer to the farmer, the Government has continued to set maximum retail price. Fertilizer subsidy has also been introduced (since 1992) so as to cushion the effect of the currency devaluation (introduced in 1992).[24] The magnitude of the subsidy has averaged about 56.9 Birr per quintal (DAP). This is derived on the basis of an official "cost-build-up," which amounts to 256.9 Birr, worked out by taking average c.i.f. import prices to Assab plus local distribution costs incurred in importing and marketing fertilizer.[25] Transport costs vary significantly from one region to another, with the subsidy to farmers increasing as the distance from the ports increase.

One of the major constraints in the wholesale and retail activities has been the pan-territorial pricing policy. The system worked against improved efficiencies in transportation and marketing through private sector initiatives and the forces of competition. Pressure to sell in the central and high consuming areas was obviously intense because the allowable profit margin was higher. Three administrative regions (Shoa, Gojjam and Arsi)[26], with relatively developed infrastructure and high agricultural potential, account for over 70 percent of the total fertilizer consumption in the country. Suppliers operating in these areas face lower costs and have greater potential profits. Those forced to sell in distant and low potential areas often lost money.

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22 USAID was able to dock 46,000 tons at Assab for its food aid shipment recently. It is also possible to use the method of mid-stream discharge if the existing docks are unable to handle bigger ships. Such vessels are unloaded onto smaller ships (with a capacity of 3000 tons) for discharge at the shore.

23 This includes the share of Ambassel Trading Enterprise which also acts as a wholesale agent for AISCO

24 A subsidy of 15% was introduced in 1993, thereby reducing the price of DAP to Birr 149.70 per quintal. But the price was still about 40% higher than the price in 1992. A total of 50 million Birr was allocated annually by the Government in the form of subsidy to ease the effect of the price increase during the period of 1994 to 1996. The actual amount paid by the Ministry of Finance in 1994 was 49.1 million and the annual payment is estimated to exceed 136.5 million (569*240,000) in 1995 and 1996.

25 This means the farmers pay 200 Birr per quintal

26 These names are according to the old administrative arrangements.

The Government is committed to deregulating fertilizer prices and removing subsidies with the aim of making the market more efficient and sustainable.[27] The implications of lifting the pan-territorial price system and removal of subsidies are assessed by assuming that fertilizer will be distributed from the port of Assab to 24 different locations, evenly distributed throughout the main cereal growing areas. The transport cost to each location is obtained by multiplying the distance from Assab and the corresponding freight rates (obtained from Ministry of Transport and Communications). A further transport cost of 37.5 Birr per ton is added to cover the transport cost from these locations to the retail points.[28] The total transport cost is added to the 1996 average CIF, bank charges, handling costs, inspection expenses, etc. to obtain the deregulated and unsubsidized fertilizer price for the base case or Scenario 1.

Scenario 1 represents a situation in which deregulation and removal of subsidies are accompanied by no cost savings. The market remains dominated by AISCO and EAL and institutional/administrative constraints continue to impeded free competition.[29] This gave a price which markedly varies between regions, but the average weighted price of fertilizer (DAP) 2611.45 Birr/ton or 261.15 Birr/quintal (Table 7), implying an additional cost of 4.25 Birr/quintal, compared to the unsubsidized and pan- territorial (1996) price of 256.9 Birr/quintal. The difference is due to the more realistic provision for transport costs in estimating the deregulated price.[30]

If fertilizer prices were deregulated and subsidies were removed (Scenario 1), farmers would face a price which is 20.69 to 38.93 percent higher than the actual price faced in 1996. Areas with very high transport costs such as Gondar, Harar and Mekelle will end up paying over 270 Birr/quintal (over 35 percent increase over the 1996 actual price).

Given the mean reservation price of 245 Birr/qt, the deregulated price under Scenario 1 may result in a reduced fertilizer demand. In particular, in low potential and distant/remote areas such as Gondar and Tigray, some farmers may be forced out of the fertilizer market. Thus, it is important to ensure that the deregulation measures are accompanied by reduced costs or other measures to encourage farmers to use fertilizer as efficiently as possible.

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[27] Pan-territorial prices are expected to be gradually phased out, beginning with decontrol of retail prices before the end 1996, decontrol of wholesale prices by Dec. 31, 1997, and complete decontrol (i.e. distributors' prices) by the close of 1998. According to the board fertilizer retail price subsidy will continue to until September 30, 1996 after which only targeted subsidies would continue to promote fertilizer use in low- using, inaccessible areas with potential (World Bank, 1995).

[28] In each case, a distance of 75 kms and freight rates of 0.05 Birr per quintal per km (or 0.5 Birr/ton/km) is assumed.

[29] See Mulat, Ali and Jayne, 1996 for more details.

[30] The unsubsidized price makes insufficient allowance for transport. Fertilizer distribution in distant areas has been constrained because of, among others, the low transport cost. EAL claims that the 256.9 Birr/quintal unsubsidized price set by the government leaves the company with a loss of 12.63 Birr/quintal on its DAP purchase in 1996.

Scenario 2 assumes that costs can be reduced due to private sector initiatives or competitive system of fertilizer import and distribution following the price de-control measures. Some of the inefficiencies noted above are assumed to be tackled and the institutional constraints are addressed, leading to the following savings in the short-run.[31]

		Savings USD/ton
-	adjusting the time of purchase or timely and streamlined allocation forex	10.0
-	remove restriction on the country of origin of the supplies	4.0
-	more competitive bidding	2.0
-	economies of scale in purchase	5.0
-	using chartered vessels	5.0
-	using bigger vessels	4.0
-	improving port and clearing service	2.0
-	competitive wholesale and retail oper.	1.0
-	competitive transport and storage serv.	2.0
	Total cost reduction	35.0 or 222.25 Birr/qt

The gains through advance purchase imply extra costs in the form of interest and storage. These costs are estimated as 34.30 Birr/ton (32.80 Birr interest and 1.50 storage). Hence, the net savings are estimated as 187.95 Birr/ton (222.25-34.30) under Scenario 2.

The average weighted price of fertilizer when price de- control and subsidy removal are accompanied by cost savings, is estimated at 2423.50 Birr/ton or 242.35 Birr/quintal. This signifies a cost reduction of 14.56 Birr/qt, compared to the pan-territorial and unsubsidized 1996 price of 256.9 Birr/qt (Table 8). All areas except Gondar would face lower prices. The gain to the economy (due to deregulation and competitive marketing) could be 49.26 million (assuming annual imports of 338,000 tons).

To conclude, there appears to be important opportunities to reduce the cost of fertilizer delivery to the farm gate. Efforts to capitalize on these opportunities would be expected to promote fertilizer profitability and use in Ethiopia, other factors held constant.

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[31] A more significant saving is expected in the long- run when more private sector participation is ensured, port facilities are competitive (Assa and Djibouti), and the transport and storage systems are improved.

Table 7. Scenario 1: Base Case Rates from Assab to Various Distribution Centers Rates for Truck with Trailer, Up to 40 Tons

	(a)	(b)	(c)=(b)+2252	(d)	(e)=(c)-(d)	(f)	(g)=(c)-(f)	(h)	(j)=(h)*(c)/100	(f)/(e)
location	distance from Assab (km)	Transport cost Assab to location (birr/ton)	Deregulated Price (birr/ton)	1996 subsidized price (birr/ton)	difference from subsidized price (birr/ton)	1996 price if unsubsidized (birr/ton)	difference from unsubsidized price (birr/ton)	Weights (% of total volume)	Average price after deregulation (birr/ton)	Percent increase after deregulation
Mekele	897	448	2700	2000	700	2569	131	2	72	35
Gonder	1053	526	2778	2000	778	2569	209	2	61	38
Merawi	1029	344	2596	2000	596	2569	27	4	121	29
Finote Selam	1293	433	2685	2000	685	2569	116	4	125	34
Debre Markos	1181	395	2647	2000	647	2569	78	4	123	32
Bichena	1147	384	2636	2000	636	2569	67	4	122	31
Kombolcha	490	161	2413	2000	413	2569	-155	0	6	20
Sokoru	1201	360	2612	2000	612	2569	43	4	112	30
Debre Berhan	935	336	2588	2000	588	2569	19	4	111	29
Nekempt	1217	407	2659	2000	659	2569	90	5	135	32
Ambo	1005	336	2588	2000	588	2569	19	4	111	29
Butajira	1040	348	2600	2000	600	2569	31	4	111	30
Hosaenna	1114	373	2625	2000	625	2569	56	4	112	31
Shashemene	9860	330	2582	2000	582	2569	13	4	111	29
Sodo	1122	375	2627	2000	627	2569	58	6	166	31
Assela	861	288	2540	20000	540	2569	-28	12	304	27
Mojo	809	271	2523	2000	523	2569	-45	4	108	26
Dodola	989	341	2593	2000	593	2569	24	2	53	29
Abomsa	751	259	2511	2000	511	2569	-57	0	17	25
Harar	948	492	2744	2000	744	2569	175	2	66	37
Addis Ababa	882	295	2547	2000	547	2569	-21	4	109	27
Akaki	8610	288	2540	2000	540	2569	-28	4	109	27
Jimma	1225	410	2662	2000	662	2569	93	5	140	33
Arba Minch	1219	408	2660	2000	660	2569	91	3	94	33
									2611	

cif cost + all fixed costs (birr/ton)

cif value	1887.9000	spoilage, wastage, spillage	4.8000
bank charge	28.0000	bank interest charge	98.3000
handling/clearing	34.5000	overhead costs	26.0000
inspection	0.4000	Trans. Cost Dc-Mc	37.5000
customs duty	0.0000	mark-up @ 11 b/q)	110.0000
unloading / loading at DC & MC	20.0000	- assumed cost reduction	0.0000
storage	4.6000		

TOTAL (@11 BIRR/Q MARKUP) 2252.0000

Table 8. Scenario 2: Assume 187.95 birr/quintal Cost Reduction from More Competitive Private Sector Distribution Rates from Assab to Various Distribution Centers Rates for Truck with Trailer, Up to 40 Tons

location	(a) from Assab distance (km)	(b) transport rate (birr/q/km)	(c)=(a)*(b) Transport cost Assab to location (birr/ton)	(d)=(c)+2064.05 Deregulated Price (birr/ton)	(e) 1996 subsidized price	(f)=(d)-(e) diff. from subsidized p (birr/ton)	(g) 1996 unsubsidized price	(h)=(d)-(g) diff.from unsubsidized p (birr per ton)	(I) Weights	(j)=((I)*(d))/100 Aver price aft der	(f)/(e) % incr after dereg
Mekele	897.0000	0.0500	448.5000	2512.5500	2000.0000	512.5500	2569.0000	-56.4500	2.6700	67.0851	25.6275
Gonder	1053.0000	0.0500	526.5000	2590.5500	2000.0000	590.5500	2569.0000	21.5500	2.2300	57.7693	29.5275
Merawi	1029.0000	0.0335	344.7150	2408.7650	2000.0000	408.7650	2569.0000	-160.2350	4.6600	112.2484	20.4382
Finote Selam	1293.0000	0.0335	433.1550	2497.2050	2000.0000	497.2050	2569.0000	-71.7950	4.6600	116.3698	24.8603
Debre Markos	1181.0000	0.0335	395.6350	2459.6850	2000.0000	459.6850	2569.0000	-109.3150	4.6600	114.6213	22.9842
Bichena	1147.0000	0.0335	384.2450	2448.2950	2000.0000	448.2950	2569.0000	-120.7050	4.6600	114.0905	22.4147
Kombolcha	490.0000	0.0330	161.7000	2225.7500	2000.0000	225.7500	2569.0000	-343.2500	0.2900	6.4547	11.2875
Sokoru	1201.0000	0.0300	360.3000	2424.3500	2000.0000	424.3500	2569.0000	-144.6500	4.3000	104.2471	21.2175
Debre Berhan	935.0000	0.0360	336.6000	2400.6500	2000.0000	400.6500	2569.0000	-168.3500	4.3000	103.2279	20.0325
Nekempt	1217.0000	0.0335	407.6950	2471.7450	2000.0000	471.7450	2569.0000	-97.2550	5.0900	125.8118	23.5872
Ambo	1005.0000	0.0335	336.6750	2400.7250	2000.0000	400.7250	2569.0000	-168.2750	4.3000	103.2312	20.0362
Butajira	1040.0000	0.0335	348.4000	2412.4500	2000.0000	412.4500	2569.0000	-156.5500	4.3000	103.7353	20.6225
Hosaenna	1114.0000	0.0335	373.1900	2437.2400	2000.0000	437.2400	2569.0000	-131.7600	4.3000	104.8013	21.8620
Shashemene	986.0000	0.0335	330.3100	2394.3600	2000.0000	394.3600	2569.0000	-174.6400	4.3000	102.9575	19.7180
Sodo	1122.0000	0.0335	375.8700	2439.9200	2000.0000	439.9200	2569.0000	-129.0800	6.3500	154.9349	21.9960
Assela	861.0000	0.0335	288.4350	2352.4850	2000.0000	352.4850	2569.0000	-216.5150	12.0000	282.2982	17.6242
Mojo	809.0000	0.0335	271.0150	2335.0650	2000.0000	335.0650	2569.0000	-233.9350	4.3000	100.4078	16.7532
Dodola	989.0000	0.0345	341.2050	2405.2550	2000.0000	405.2550	2569.0000	-163.7450	2.0800	50.0293	20.2627
Abomsa	751.0000	0.0345	259.0950	2323.1450	2000.0000	323.1450	2569.0000	-245.8550	0.7000	16.2620	16.1572
Harar	948.0000	0.0520	492.9600	2557.0100	2000.0000	557.0100	2569.0000	-11.9900	2.4200	61.8796	27.8505
Addis Ababa	882.0000	0.0335	295.4700	2359.5200	2000.0000	359.5200	2569.0000	-209.4800	4.3000	101.4594	17.9760
Akaki	861.0000	0.0335	288.4350	2352.4850	2000.0000	352.4850	2569.0000	-216.5150	4.3000	101.1569	17.6242
Jimma	1225.0000	0.0335	410.3750	2474.4250	2000.0000	474.4250	2569.0000	-94.5750	5.2700	130.4022	23.7212
Arba Minch	1219.0000	0.0335	408.3650	2472.4150	2000.0000	472.4150	2569.0000	-96.5850	3.5600	88.0180	23.6208
										2423.4995	

cif cost + all fixed costs (birr/ton)

cif value	1887.90		bank interest charge	98.30
bank charge	28.00		overhead costs	26.00
handling/clearing		34.50	Trans. Cost Dc-Mc	37.5000
inspection	0.40		mark-up @ 11 b/q)	110.0000
customs duty	0.00		- assumed cost reduction	-187.9500
unloading / loading at DC & MC	20.00		TOTAL (@11 BIRR/Q MARKUP)	2064.0500
storage	4.60			
spoilage, wastage, spillage	4.80			

3.2. The Impact on Fertilizer Profitability

-The estimated profitability of fertilizer use after deregulation and subsidy removal is shown on Table 9.[32] The mean VCR for the maize areas was 1.77 and 1.90 under scenario 1 and 2, respectively. The corresponding mean estimates of VCR for Teff were 2.05 and 2.21 and for wheat 2.70 and 2.91. The major conclusion from this analysis is that if deregulation is not accompanied by savings in the cost of fertilizer (scenario 1), the VCR would fall below 2 for 65 percent of the areas under consideration. In particular, only 48 percent of the teff-growing and 31 percent of the maize areas attained a VCR greater than 2. The profitability of wheat has, however, remained above the minimum (VCR of 2) in all but 2 cases.

Table 9. Summary of Value Cost Ratios (VCRs) for Scenario 2 (Deregulation of Fertilizer Pricing Associated with Cost Reduction in Private Distribution), for Selected Crops

Crops	No. Of Sites	VCR 96 Scenario 2			VCR 96 Scenario 1		
		Range	Mean	No. of sites with > 2	Range	Mean	% of sites > 2
Teff	25	0.41-3.74	2.21	12 (48)	0.38-3.46	2.05	12 (48)
Maize	13	0.67 - 3.06	1.90	5 (38)	0.63-2.84	1.77	4 (31)
Wheat	8	1.71-4.62	2.91	7 (88)	1.58-4.28	2.70	6 (75)
Barley	3	1.72-2.98	2.35	2 (67)	1.59-2.76	2.17	2 (67)
Millet	2	1.27-2.44	1.86	1 (50)	1.18-2.26	1.72	1 (50)

The cost saving scenario (Scenario. 2) has not significantly improved the profitability of fertilizer in most cases. The mean VCR for teff increased from 2.05 (Scenario 1) to 2.21 (Scenario 2). The number of teff-growing areas with VCR greater than 2 is the same as Scenario 1 (12 sites or 48% in both cases). In the case of maize, the proportion of areas with VCR greater than 2 increased to 38%, compared to 31% under Scenario 1. For wheat, the assumption of a 19 birr/q cost savings meant that only 1 site falls below 2 (compared to 2 under Scenario 1). There was no such improvement in the case of barley and millet. In fact, the profitability of fertilizer under Scenario 2 is likely to be much lower than the actual level of profitability in 1996 (subsidized and pan-territorial pricing system). The benefit in the form of cost-saving is too small to offset the loss resulting from lifting the subsidy (over 50 Birr per quintal). It thus follows that unless the deregulation is accompanied by other measures such as improvement in the performance of the grain market and/or improvement in the agronomic

[32] The output prices are the average producer prices of January to June 1996 prevailing in the area (Grain Marketing Research Project, MIS, 1996). See also Annex II for more details regarding the implication of cost saving.

efficiency of fertilizer use, the decline in profitability is likely to result in reduced demand. These measures are discussed at length in the subsequent sections.

4. THE IMPLICATIONS OF IMPROVING OUTPUT MARKET PERFORMANCE

The performance of the grain marketing system is of critical importance in the decision to use cash inputs as well as how much to use. Crop revenue must be sufficient to make the use of inputs profitable. In some cases, good national harvests may depress grain prices to such an extent that crop revenues (for households that are net sellers of grain) are lower than normal even though the farmer may have more to sell. But this possibility can be partially or wholly counteracted if measures can be adopted to improve the efficiency of the grain marketing system, as this would help relieve localized gluts that often account for depressed producer prices.

There is already evidence that grain market liberalization, initiated in Ethiopia in 1990, has raised output prices for Ethiopian farmers in major surplus-producing areas. Average cereal distribution margins have declined since liberalization, often substantially, between almost all wholesale markets in the country (Asfaw and Jayne 1997). These reductions in grain distribution margins are, by definition, passed on to consumers (in the form of lower retail prices) and/or producers (in the form of higher producer prices). The extent to which liberalization has affected equilibrium cereal prices has been estimated in somewhat different ways by Dercon (1995) and Asfaw and Jayne (1996). Both studies conclude that farm output prices have generally increased after liberalization. For example, Asfaw and Jayne estimate that grain market liberalization has raised equilibrium maize prices in Shashemene and Bako, two important maize producing areas, by 29 Birr/quintal and 21 Birr/quintal, respectively.

However, these findings do not indicate that Ethiopian grain markets are performing optimally or that further reductions in marketing costs are not possible. The system still suffers from a number of constraints that impose heavy costs on farmers and food consumers. The limited number of large inter-regional traders and their constrained access to working capital and storage and poor road conditions have resulted in geographical pockets of agricultural surplus facing low prices and deficit areas with high prices. Small traders have little or no capacity of holding large quantities for longer duration (time utility). In the absence of sufficient stock, the volume of grain marketed falls sharply in years of poor harvest and prices tend to increase significantly. Weak infrastructure, both within Ethiopia and between Ethiopia and other countries in the region, inflate transfer costs and impede the viability of trade that would otherwise moderate extreme price fluctuations.

Is it feasible to expect that further improvements in the grain marketing system can raise average cereal producer prices by 10-15 Birr per quintal? On-going research by the MEDAC Grain Market Research Project indicate that grain checkpoint taxes (taxes on the movement of grain between regions) increased grain marketing costs between 4 to 15 birr per quintal on major grain trading routes in 1996 (i.e., about 20% to 33% of observed price spreads between major wholesale markets in the country). These checkpoint taxes clearly reduce producer prices and revenues. If the checkpoint taxes on grain were removed, this might require different means of raising revenue for the regional governments, but would directly stimulate grain production incentives and fertilizer use in major surplus-producing areas, and at least partially offset the effects of eliminating fertilizer subsidies from the standpoint of the farmer.

In fact, in January 1997, some regional governments announced their intention to eliminate or reduce taxation of grain movement at regional grain checkpoints.

To estimate how continued cost reduction in the grain marketing system may affect fertilizer demand, we estimate how an additional 10 Birr/qt increase in all grain prices would affect fertilizer VCRs. The results, presented in Table 10, indicate that the number of areas with VCR greater than 2 increases to 31, compared to 26 with no improvement in price. The mean VCR also increases by 9.3 percent, from 2.11 (no price improvement) to 2.31 (with price improvement).[33]

Table 10. Summary of Value Cost Ratios (VCRs) for Scenarios 1 and 2, Under the Assumption of a 10 birr/quintal Increase in Producer Grain Prices

Crops	No. Of Sites	VCR 96 Scenario 2			VCR 96 Scenario 1		
		Range	Mean	No. of sites with > 2	Range	Mean	% of sites > 2
Teff	25	0.43-3.57	2.23	13 (52)	0.39-3.40	2.09	12 (48)
Maize	13	0.77 - 3.32	2.09	7 (54)	0.65-2.88	1.80	4 (31)
Wheat	8	1.71-4.63	2.94	7 (88)	1.56-4.23	2.70	6 (75)
Barley	3	1.75-3.16	2.46	2 (67)	1.61-2.80	2.20	2 (67)
Millet	2	1.34-2.65	2.00	1 (50)	1.19-2.46	1.83	1 (50)

The major conclusion of this section is that the performance of the grain marketing system in Ethiopia strongly influences the profitability of fertilizer use by farmers. A more efficient marketing system can help pull grain quickly out of surplus areas, thus relieving the localized gluts that depress farm prices, and more quickly deliver grain to deficit areas. Measures that are likely to improve the efficiency of the grain market include investment in timely and widely disseminated market information, improved storage facilities, and improved road infrastructure both within Ethiopia and between Ethiopia and its regional neighbors. A considerable part of the food price instability problem in Ethiopia is related to the high cost of transportation, which creates a large wedge between import and export prices. For example, when areas of Southern Ethiopia are in grain surplus, prices are depressed by high transport costs that limit grain export opportunities. When these areas are in grain deficit, prices are driven upward by the high cost of transporting grain to these areas from other regions. Government and donor support for improved road infrastructure and lower transport costs (both within Ethiopia and between Ethiopia and its regional neighbors) would benefit both producers and consumers and further increase the benefits of market liberalization.

[33] Annex III provides the detailed calculations for each production site.

Other research on the behavior of wholesale traders (Eleni, forthcoming) indicates the scope for reducing handling and transaction costs if improvements in cereal grading and standards could be achieved. For example, inadequate grading procedures cause grain to be un-bagged and re-bagged for quality inspection each time grain changes hands. These findings are indicative of an emerging body of empirical evidence on policy reform in Africa suggesting that, while some reforms have been critical to promote economic growth, they are insufficient by themselves to generate leaps in productivity growth and require associated improvements in key market institutions, contract enforcement, and broader nurturing of civil society.

Efforts to reduce grain marketing costs should be viewed as a critical component in the overall strategy to stimulate fertilizer demand and crop productivity. This conclusion underscores the importance of viewing productivity growth from a 'systems perspective' in which investments and policy changes made at one stage in the food system (e.g. marketing) may influence the viability of investments made at other stages (e.g. technology adoption at the farm level).

5. IMPROVING THE YIELD RESPONSE TO FERTILIZERS

5.1. Constraints to Improved Yield Response

The improvement of the input and grain market alone may not be adequate to improve the profitability of fertilizers. In fact, it may be extremely costly to stabilize grain prices through support price schemes alone. Higher grain prices may also be undesirable from the viewpoint of the urban consumers and the net buyers in the rural areas. Higher food costs can result in pressures to raise wages, thereby reducing the competitiveness of the non-agricultural sector. Lower grain prices can also stimulate the development of processing industries. An important means of promoting the twin goals of lower grain prices for consumers and higher returns to farmers is to improve the output response to fertilizers.

Management factors, use of complementary inputs and environmental differences often result in significant variations of yield response to fertilizer application. Among the factors which can cause the greatest reduction in the fertilizer efficiency are inappropriate crop variety, poor land preparation, untimely sowing, unbalanced fertilizer application, weed infestation and insect attack (FAO, 1987). According to Heisey and Mwangi (1996), for instance, the response of maize in Africa can be classified in to three: high response areas where the marginal response (at 0 kg/ha nitrogen) is 25 kg of grain or more per 1 kg of nutrient; intermediate response areas where the equivalent figure is 15 kg of grain per 1 kg of nutrient; and low response areas where the marginal response is 5 to 14 kg of grain per 1 kg of nutrient. The average yield response of 7.44 quintals per 1 quintal of DAP, according to KUAWAB/DSA (1995) study, is equivalent to 11.6 kg of grain per 1 kg of nutrient.[34]

The yield response to fertilizer use has been low in Ethiopia because of the continued reliance on low-yielding local cultivars, cultural practices that achieve certain objectives but are not consistent with crop yield growth, sub-optimal nutrient use and lack of complementary inputs.[35] Although adapted to various agro-climatic conditions, local land races are of low genetic potential, and because of their weak stems, have lodging (toppling over) problems, particularly at high doses of fertilizer. Thus the marginal productivity of incremental fertilizer declines at higher application levels, necessitating the use of improved seed to generate higher yields. Some of the released crop varieties are resistant to lodging and are highly responsive to added nutrients. However, the use of improved crop varieties is limited, only 0.75 percent of the cereal land was planted with improved seeds in 1996 (Table 12). The use of improved seeds is particularly low (0.48%) in the case of teff which is the most fertilized crop. The proportion is relatively higher in the case of wheat (2.35%) and maize (1.22%). Most of the released varieties have also lost their resistance to diseases especially in the case of wheat. A study in Arsi Negele found that the average yield of improved wheat variety is not significantly different from the average yield of local variety (Lesesse 1992). Improved sorghum varieties

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[34] 1 quintal of DAP contains 46 kg of P_2O_5 and 18 kg of nitrogen or 64 kg of nutrient.

[35] The low level of fertilizer efficiency is also confirmed by a recent study on technical efficiency of small farmers (Croppenstedt and Mulat, 1996). The study concluded that the average efficiency of fertilizer is only 40%, compared to 75% for land and 55% for labor. The overall technical efficiency is decomposed into the efficiency of the respective inputs.

are susceptible to damage by birds and have short stalks, undesirable characteristics because the stalks are needed for fuel and construction purposes.

Farm management practices are among the important determinants of the output response to fertilizer application. The rate and time of fertilizer application, the control of weeds, diseases and pests, the level of organic matter in the soil, drainage conditions (in water-logged areas) and moisture conservation (in moisture-stress areas) have significant influence on the return from fertilizer use. The use of complementary inputs and cultural practices are indispensable components the package necessary to improve the efficiency of fertilizers.

The new extension program is based on the application of 100 kg of DAP (46 kg P_2O_5 and 18 kg N) and 100 kg urea (46 kg N) per hectare. These are obviously very broad recommendations which require refinement for different agro-ecological environments. The great diversity of the soil and weather conditions, and the numerous crops grown require soil- and crop-specific recommendations.

Unbalanced nutrient use is another serious constraint in the efficient utilization of fertilizer. While the recent recommendation states that DAP and urea should be applied in equal proportion (100 kg DAP and 100 kg urea), the farmers' practice is heavily biased towards one type of fertilizer use, mainly DAP. The previous extension approach paid limited attention to the application of urea. About 56 percent of the cereal fertilized area received only DAP and another 8.5 percent only urea in 1996 (Table 13). Although 34.2 percent of the cereal area was fertilized with DAP and urea, the proportion in which the two were combined is unlikely to be 1:1 as per the recommendations. The loss of output due to nutrient imbalance is quite significant. For the same amount of expenditure, farmers can obtain a higher yield response if they buy both DAP and urea, instead of DAP only.

Correct timing of fertilizer application is of great practical importance in achieving adequate yield response. However, the distribution problem (section 3 above) has meant that farmers often cannot apply fertilizer at the right time. For instance, though the delivery in 1994 was considered to be better compared to the previous years, 67% of the surveyed farmers still reported that delivery was not on time (KUAWAB/DSA, 1995). Not recognizing the different planting calendar of the various regions, fertilizers are mostly scheduled to be delivered in June and July. The distribution practice does not consider the planting time of maize, sorghum and 'belg' crops which is 2 to 3 months earlier than June. During the current 1996/97 season, for instance, no fertilizer was made available for belg crops.

The reduction in the amount of soil humus or organic matter may lead to spectacular declines in soil productivity. Inorganic fertilizers also yield lower output on such soils. Adequate return from commercial fertilizers can be obtained only when used in combination with organic fertilizers. Natural fertilizers help to avoid nutrient leaching and improving soil conditions, hence improve the performance of commercial fertilizer (Asnakew, et al, 1991). Organic fertilizers in the form of green-manure crops, farm yard manure, and compost and organic waste supply the soil and crops with nutrients, improve soil physical conditions. Farmers can grow green-manure crops in fallow areas or short-season leguminous crops during the short rains for improving fertility of the soil through nitrogen fixation and for conserving soil against erosion (by acting as a cover crop). Nonetheless, only 1.4 percent of the cereal land was fertilized with both chemical and organic fertilizers in 1996 (Table 13). Green-manuring has yet to be introduced in Ethiopia. Although, the importance of farm yard manure in improving soil fertility is well known among small farmers, the availability of animal manure has been declining because of its use as fuel. The introduction of small biogas plants for cooking and lighting can solve the fuel problem and allow a full recovery of animal dung for use as manure. But lack of progress in commercializing the technology has restricted its use to experimental or demonstration purposes. If properly planned and promoted, the contribution of organic fertilizer to the Ethiopian agriculture can be quite significant.

The efficiency of nitrogen use is generally low in Ethiopia because of poor land preparation. Most of the nitrogen applied to soils is lost by leaching, denitrification, volatilization, etc. One study (Ali 1992) showed that the Nitrogen use efficiency of durum wheat improved from 39% to 70% by employing improved drainage alone. Poor drainage systems have reduced the efficiency of fertilizer use in many water-logged and/or vertisol areas. Improved drainage implements such as the Broad Bed Maker (BBM) (developed by the International Livestock Center for Africa) is still unknown to most farmers.

Moisture stress is a major limiting factor to profitable use of fertilizer in many drier parts of the country. Only 0.83 percent of the cereal land was irrigated in 1996 (Table 12). Although cultural practices such as mulching and tie ridging can significantly improved nutrient uptake (N and P), very few farmers have adopted these methods. The attention given to the popularization of such practices is insufficient.

Fertilizer productivity is also reduced due to weed and disease infestation (pre-harvest loss of output). It has often been stated that pests and diseases at the pre- and post-harvest stages can cause up to 15-20% crop losses in Ethiopia. Climatic conditions during the rainy season and overlapping farm activities at the time of weeding deter timely removal of weeds. Various pests cause losses in the field and in storage. However, the current level of pesticide and herbicide use is minimal. Of the total cereal area, only 10.83 percent received pesticides (including herbicides) in 1996 (Table 12). The market for these inputs is poorly developed and needs to encouraged for increased agricultural production without however loss of sight of the possible implications for the environment. Lack of quality control has also created serious problem.

The traditional plough is inefficient in terms of depth, width of operation and pulverization of the soil. It is of very little use in inverting and cutting the soil. It is ineffective against weeds as it does not bury the stubble. The development of a suitable moldboard plough as a replacement for the traditional plough has continued to prove difficult with the major obstacle being cost, weight and maintenance. Poor seedbed preparation is also caused by shortage of oxen and dry-season feed (causing weak oxen). Poorly prepared land leads to poor plant establishment, heavy weed infestation and low yields.

Table 11. Estimate of Improved Seed, Irrigation and Fertilizer Applied Area and Their Percentage Distribution by Crop for Meher Season of Private Holdings, 1995/96 (1988 Ec)

Type of crop	Total Crop	Improved Seed Applied		Irrigation		Pesticides		Fertilizer	
	Area	Area	%	Area	%	Area	%	Area	%
CEREALS	6,652.55	49.69	0.75	55.07	0.83	720.31	10.83	2,466.92	37.08
Teff	2,097.40	10.05	0.48	4.49	0.21	346.74	16.53	1,094.87	52.20
Barley	825.54	**	**	1.40	0.17	50.70	6.14	242.48	29.37
Wheat	882.06	20.76	2.35	1.89	0.21	159.16	18.04	452.38	51.29
Maize	1,280.68	15.57	1.22	21.81	1.70	87.73	6.86	465.25	36.33
Sorghum	1,252.41	1.96	0.16	**	**	70.77	5.65	87.02	6.95
Millet	269.35	**	**	**	**	3.15	1.17	103.71	38.50
Oats	45.11	-	-	**	**	2.06	4.57	21.21	47.02
PULSES	904.39	**	**	5.30	0.59	29.16	3.22	101.21	11.19
Horse Beans	336.72	**	**	**	**	11.04	3.28	50.65	15.04
Field Peas	180.46	**	**	-	-	9.26	5.13	20.76	11.50
Haricot Beans	101.17	**	**	**	**	5.17	5.11	13.58	13.42
Chick Peas	144.97	**	**	1.93	1.33	2.21	1.52	7.01	4.84
Lentils	65.12	-	-	**	**	0.75	1.15	6.83	10.49
Vetch	75.95	**	**	**	**	**	**	2.38	3.13
OILSEEDS	377.70	**	**	**	**	7.61	2.01	22.87	6.06
Neug	223.33	**	**	**	**	2.45	1.10	4.72	2.11
Lin Seed	112.72	-	-	**	**	0.81	0.72	3.64	3.23
Rape Seed	14.19	-	-	-	-	0.80	5.64	**	**
Ground Nuts	13.26	-	-	**	**	**	**	**	**
Sun Flower	4.78	-	-	-	-	1.25	26.15	**	**
Sesame	9.39	**	**	-	-	**	**	-	-
Castor Bean	**	-	-	-	-	-	-	**	**
OTHERS	179.42	**	**	4.89	2.73	13.22	7.37	68.48	38.17
Fenugreek	13.90	**	**	**	**	**	**	1.97	14.17
Spicies	45.50	**	**	**	**	4.58	10.07	17.68	38.86
Potatoes	38.71	**	**	**	**	2.33	6.02	22.99	59.39
Other Temporary	81.31	**	**	2.25	2.77	**	**	25.84	31.78
ALL TEMPORARY	8,114.06	52.27	0.64	65.31	0.81	770.30	9.49	2659.48	32.78
Chat	86.76	-	-	7.32	8.44	6.24	7.19	27.08	31.21
Coffee	202.13	9.33	4.62	4.95	2.45	29.90	14.79	23.08	11.42
Enset	223.81	-	-	**	**	8.53	3.81	119.28	53.30
Cotton	14.88	-	-	**	**	1.59	10.69	0.74	4.97
Tobacco	1.27	**	**	-	-	**	**	0.28	22.05
Fruits	17.82	**	**	2.75	15.43	2.96	16.61	4.25	23.85
Other Permanent	26.40	**	**	3.40	12.88	1.66	6.29	5.72	21.67
TOTAL PERMANENT	573.07	9.57	1.67	19.33	3.37	50.95	8.90	180.43	32.53
ALL CROPS	8,687.13	61.84		84.64		821.25		2,839.91	

**: nil

Source: CSA

Table 12. Estimates of Quantity of Commercial Fertilizer by Type of Fertilizer for Meher Season Crops of Private Holdings in 1995/96 (1988 E.C.)

Type of Crop	Total Quantity	DAP		UREA		DAP + UREA		COMM W/NAT	
		Quantity	%	Quantity	%	Quantity	%	Quantity	%
CEREALS	2,339.70	1,309.33	55.96	198.71	8.49	798.92	34.15	32.73	1.40
Teff	1,185.79	569.76	48.05	76.69	6.47	533.12	44.96	6.22	0.53
Barley	192.00	156.64	81.58	19.01	9.90	14.46	7.53	1.89	0.98
Wheat	555.95	271.26	48.79	48.85	8.79	230.87	41.53	4.98	0.90
Maize	273.06	209.14	76.59	34.21	12.53	15.41	5.64	14.29	5.23
Sorghum	45.52	22.32	49.03	14.46	31.77	3.46	7.60	5.27	11.58
Milet	73.99	69.00	93.26	4.45	6.01	**	**	**	**
Oats	13.39	**	**	**	**	**	**	**	**
PULSES	87.60	57.46	65.59	12.51	14.28	13.57	15.49	**	**
Horse Beans	36.52	30.11	82.45	4.12	11.28	1.50	4.11	**	**
Field Peas	14.70	8.96	60.95	**	**	**	**	**	**
Haricot Beans	21.64	**	**	6.34	29.30	**	**	**	**
Chick Peas	4.86	**	**	**	**	0.87	17.90	-	-
Lentils	6.60	2.79	42.27	**	**	**	**	**	**
Vetch	**	**	**	**	**	**	**	-	-
OILSEEDS	20.04	18.34	91.52	**	**	**	**	**	**
Neug	**	**	**	**	**	-	-	-	-
Lin Seed	**	**	**	**	**	**	**	-	-
Rape Seed	12.09	11.61	96.03	-	-	**	**	**	**
Ground Nuts	0.82	**	**	**	**	**	**	**	**
Sun Flower	**	**	**	-	-	**	**	-	-
Sesame	**	**	**	-	-	-	-	-	-
Castor Bean	-	-	-	-	-	-	-	-	-
OTHERS	69.20	56.50	81.65	5.70	8.24	2.99	4.32	4.01	5.79
Fenugreek	1.13	0.87	76.99	**	**	**	**	**	**
Spicies	**	**	**	**	**	**	**	**	**
Potatoes	28.25	21.73	76.92	3.21	11.36	**	**	**	**
Other Vegetables	10.77	7.22	67.04	1.03	9.56	0.93	8.64	**	**
ALL TEMPORARY	2,516.54	1,441.63	57.29	217.68	8.65	815.94	32.42	41.28	1.64
Chat	26.50	**	**	10.55	39.81	4.04	15.25	4.23	15.96
Coffee	9.06	6.62	73.07	1.43	15.73	**	**	**	**
Enset	2.55	1.67	65.49	**	**	**	**	**	**
Cotton	**	-	-	**	**	**	**	-	-
Tobacco	**	**	**	**	**	-	-	-	-
Fruits	3.26	**	**	**	**	**	**	**	**
Other Permanent	4.15	1.84	44.34	**	**	**	**	**	**
TOTAL PERMENT	45.63	19.33	42.36	13.31	29.17	5.21	11.42	7.78	17.05
ALL CROPS	2,562.77	1,460.96		230.99		821.15		49.06	

5.2. The Implications of Improving Output Response

The discussion above clearly indicates that the scope for increasing yield response is significant. Wheat and maize yield levels in Ethiopia are below the average for Africa. according to FAO Yearbook, maize and wheat yield levels were 14.8 qt/ha and 17.3 qt/ha, respectively, in 1994.[36] The comparative figure for Africa was 18.4 qt/ha and 17.8 qt/ha. Wheat ad maize yields were much higher in Zambia (23.9 and 20.5 qt/ha, respectively), Zimbabwe (67.5 and 17.62 qt/ha) and Kenya (14.8 and 20.5 qt/ha, respectively).

Improved cultural practices, balanced and optimal nutrient application and the use of complementary inputs can significantly increase the efficiency of fertilizer use in Ethiopia. To assess what such yield response improvements would do to the profitability of fertilizer use, we calculated the VCR estimates for each site under the assumption of a 20 percent increase in yield response. Summary results are presented in Table 14 (full results are in Annex V). Overall, the mean VCR increases by 20 percent, from 2.11 (no improvement in response) to 2.53 (with the assumed 20% increased yield response). In other words, the VCR improves by 20 percent in the case of teff, maize, wheat, barley and millet. Of the 51 areas under consideration, about 69 percent (35 areas) attained a VCR in excess of 2, given the unsubsidized price and producer (output) price of 1996.

Table 13. Summary of Value Cost Ratios (VCRs) for Scenarios 1 and 2, Under the Assumption of a 20 Percent Increase in Crop Yield Response

Crops	No. Of Sites	VCR 96 Scenario 2			VCR 96 Scenario 1		
		Range	Mean	No. of sites with > 2	Range	Mean	% of sites > 2
Teff	25	0.39-3.40	2.09	12 (48)	0.47-4.08	2.51	18 (72)
Maize	13	0.65 - 2.88	1.80	4 (31)	0.78-3.45	2.16	7 (52)
Wheat	8	1.56-4.23	2.70	6 (75)	1.88-5.08	3.24	7 (88)
Barley	3	1.61-2.80	2.20	2 (67)	1.93-3.36	2.64	2 (67)
Millet	2	1.19-2.46	1.83	1 (50)	1.43-2.95	2.19	1 (50)

[36] These figures for Ethiopia are apparently much higher than the ones reported in national survey reports (e.g. CSA reports).

5.3. The Implications of Reallocating Fertilizer Use to High Value Crops

The allocation of fertilizer to high-value crops such as vegetables, cotton (peasant sector), oilseeds, coffee, pulses, etc. is low relative to cereals. For instance, the proportion of fertilized area of cotton, coffee, fruits and chat (in the total area) was only 5.0, 11.4, 23.8 and 31.21 percent, respectively in 1996 (Table 13). Similarly, only 6.1 and 11.2 percent of the oilseeds and pulse areas were fertilized, although both crops are important (next to coffee) export crops. Moreover, the average rate of fertilizer application for permanent crops (most of which are high value crops) was only 25.3 kg/ha, compared to 95 kg for cereals (computed from Tables 12 and 13). The profitability of fertilizer and the return to land and labor can be improved significantly by allocating more fertilizer to these crops. Depending on the agroecological conditions, high-value cash crops can serve as an engine of growth in the development of Ethiopian agriculture. Revenues from cash crops can be used to finance the acquisition of new technologies. A number of studies have shown the positive interactions between production of cash crops and food crops (e.g. Dione, 1989; Staatz, 1989). The benefits of the agronomic interactions (in the form of crop rotation) between leguminous crops such as pulses and oilseeds are also considerable.

6. INTEGRATED APPROACH TO IMPROVE FERTILIZER PROFITABILITY

A concerted effort in all areas is expected to make the use of fertilizer attractive to farmers even in remote and marginal areas. Table 15 depicts the profitability of fertilizer in which all the best scenarios in the input market (i.e. deregulated price with cost savings), grain market (10 Birr/qt increase in prices) and yield response (20% increase in productivity) are combined. The impact on fertilizer profitability was dramatic. The mean VCR (for the overall) jumped to 2.94, signifying a 39% increase over the VCR obtained under the unsubsidized fertilizer price of 1996. Close to 9 percent improvement in profitability was also observed in relation to the 1996 subsidized price of fertilizer (VCR 2.71).[37]

Under the integrated approach, the VCR estimates exceeded 2 for all areas where wheat is the dominant crop. Of the 13 maize-growing areas, only 2 (15%) areas had less than 2. About 76 percent of the teff-growing areas attained a VCR in excess of 2.

Table 14. Summary of Value Cost Ratios (VCRs) for Scenario 2 (Deregulation of Fertilizer Pricing Associated with Cost Reduction in Private Fertilizer Distribution, 25% Crop Yield Improvement, and 10 Birr/quintile Increase in Output Prices), for Selected Crops

Crops	No. of Sites	VCR 96 Subsidized			VCR 96 Unsubsidized		
		Range	Mean	No. of sites with > 2	Range	Mean	% of sites > 2
Teff	25	0.53 - 4.71	2.83	19 (76)	0.39-3.40	2.09	12 (48)
Maize	13	0.97 - 4.25	2.65	11 (85)	0.65-2.88	1.80	4 (31)
Wheat	8	2.24-6.07	3.38	8 (100)	1.56-4.23	2.70	6 (75)
Barley	3	2.24-4.04	3.15	3 (100)	1.61-2.80	2.20	2 (67)
Millet	2	1.72-3.16	2.44	1 (50)	1.19-2.46	2.19	1 (50)

The cost of the integrated approach has not been calculated. However, it can be inferred that the cost involved is likely to be much lower than the 136 million Birr spent on fertilizer subsidy in 1996. For the most part, it only requires policy measures to remove institutional barriers to an efficient operation of the whole system, ranging from production to marketing.

[37] Annex VI provides the results by site.

7. CONCLUSION AND IMPLICATIONS

In the absence of risk and transaction costs of acquiring fertilizer and selling output, a producer may be expected to operate at the point where marginal cost of the input equals its marginal revenue. This would imply a value-cost ratio (VCR) of one under some very restrictive assumptions. However, empirical investigation has found that a VCR of 2 or more has generally been needed to induce farmers to buy fertilizers. In some cases, especially where production risks are considerable, farmers may not adopt fertilizer unless the VCR is sufficiently higher than 2. It is also possible that farmers may continue to use fertilizers even when the VCR is less than 2. Where markets are sufficiently stable and well-integrated, farmers face less risk and hence may use fertilizer even when the return is less than 100% (VCR less than 2). In some areas, fertilizer may be viewed as an indispensable commodity without which little or no output is obtained to meet subsistence requirement of the farm family. Farmers who are net-buyers of grain may implicitly value their grain output at a price higher than the farm-gate price, thus fertilizer remains profitable for them even when its price is high or farm-gate output prices are low. It should be noted the capacity of these farm households to purchase fertilizer is constrained by high grain prices. When grain prices are high, expenditure on food rises, leaving less money to buy inputs.

The VCR measure underscores the fact that it is the expected revenue that determines the viability of fertilizer use, not just grain and fertilizer prices. If low grain prices occur as a result of favorable production, and farmers have more to sell than ordinarily, then the resulting revenue from crop sales may actually increase, and improve their ability to finance input purchases in the next season. For most smallholder farmers, the ability to finance the purchase of inputs is most severely constrained during a drought year. Even though output prices are high, most rural households in Ethiopia have little or no crops to sell, leaving them with insufficient revenue to buy inputs. Farm and off-farm revenue can thus be a more important determinant of both profitability of fertilizer use and farmers' ability to purchase it than crop output prices. Hence, low output prices in and of themselves do not indicate that the use of fertilizer is unprofitable.

Notwithstanding the importance of other factors, this paper has focused on three important factors which determine the profitability of fertilizer use. These are: (a) the cost of fertilizer at the farm gate; (b) the crop output price; and (c) the response rate of fertilizer application (increase in output from a given increase in fertilizer use). Evidence suggests that the existing system of fertilizer distribution in Ethiopia has resulted in inflated fertilizer prices. As a result of deregulation and further liberalization, it is estimated that the average weighted price of fertilizer can be brought down to less than 2423.50 Birr/ton or 242.35 Birr/quintal, compared to the unsubsidized price of 2569 Birr/ton or 256.9 Birr/ton in 1995/96. This is made possible through adjusting the time of purchase, removing donor restrictions that fertilizer be purchased from specific sources, importing in larger quantities, using chartered and larger vessels to take advantage of scale economies in shipping, introducing competitive wholesale and retail operation, etc.

Another important means by which the profitability of fertilizer use can be increased is to improve the functioning of the grain marketing system. Cost reduction in the marketing system will allow households that are net sellers of grain to receive higher prices (which raises the VCR), and net-grain buying households pay less for the food they buy, leaving them in a better position to afford the purchase of inputs. Data presented in this note indicate that efforts to reduce grain marketing costs should be viewed as a critical component in the overall strategy to stimulate fertilizer demand and crop productivity. Measures are needed to improve the regulatory framework of agricultural marketing, establish a viable and sustainable market analysis and information system (MIS), and introduce standard grain classification system in order to reduce transactions costs of exchange, enhance competitiveness and stabilize grain markets.

The improvement of input and grain markets alone, however, may not be adequate to improve the profitability of fertilizers. An important means of promoting the twin goals of lower grain prices for consumers and higher return to farmers is to improve the output response to fertilizers. Improved cultural practices, balanced and optimal nutrient application and the use of complementary inputs can significantly increase the efficiency of fertilizer use in Ethiopia. The mean VCR estimates, under the assumption of a 20 percent increase in yield response, increased by 20 percent, from 2.11 (no improvement in response) to 2.53 (with 20% increased response). There is also a need for greater use of fertilizer on high-value crops such as cotton, coffee, oilseeds, pulses and other cash crops which could serve as an engine of growth for agricultural development in Ethiopia.

The profitability of fertilizer can improve significantly if a concerted effort or integrated effort is made in all areas. The estimated mean VCR of fertilizer use, given a scenario in which measures are taken to improve the input market (i.e. deregulated price with cost savings), lower grain marketing margins (10 Birr/qt increase in prices) and improved yield response (20% increase in productivity), jumped to 2.94, signifying a 39% increase over the VCR obtained under the unsubsidized fertilizer price of 1996.

A major unknown in the immediate future is how the deregulation of fertilizer prices in 1997 will affect the demand for fertilizer in the coming years. The results above indicate that the answer to this question will depend largely on what other steps are taken to improve the functioning of input delivery systems, output markets, credit provision, and to improve crop management practices.

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Annex 1. Profitability of Fertilizer in Different Regions as Measured by the Value- Cost Ratio (VCR) With and Without Subsidy

Region	Most fret. crop of the area	Avr. incremental Yld in Qt 1	Average Produce price during January-June in 96 /qt 2	Value of yield in Birr increm.	DAP/ton 96 subsidized	DAP/ton 96 unsubsidized	VCR 96 subsid	VCR 96 unsubsid
S. Tigray								
Ambalagie	Mixed Wheat	2.68	215	576.2	2000	2568.7	2.88	2.24
Chercher	Mixed Teff	3.5	224	784	2000	2568.7	3.92	3.05
W. Tigray								
Lilay Keraro	Mixed Teff	3.1	224	694.4	2000	2568.7	3.47	2.70
E.Gojjam								
Guzamen	Red Teff	4.09	110	449.9	2000	2568.7	2.25	1.75
Mechakel	Red Teff	0.91	110	100.1	2000	2568.7	0.50	0.39
Shebel Bernta	Red Teff	4.37	110	480.7	2000	2568.7	2.40	1.87
N. Shoa								
Kaya Gabriel	Mixed Wheat	3.42	141	482.22	2000	2568.7	2.41	1.88
S.Gondar								
Dera	Millet	5.05	125	631.25	2000	2568.7	3.16	2.46
Iste	Red Teff	3.39	147	498.33	2000	2568.7	2.49	1.94
Kemkem	Red Teff	3.2	147	470.4	2000	2568.7	2.35	1.83
Simada	Red Teff	2	147	294	2000	2568.7	1.47	1.14
W. Gojjam								
Bahir Dar	Millet	3.83	80	306.4	2000	2568.7	1.53	1.19
Dembecha	Mixed Teff	3.14	114	357.96	2000	2568.7	1.79	1.39
Jabi Tahnan	maize	5.95	70	416.5	2000	2568.7	2.08	1.62
Quarit	Mixed Teff	2.3	132	303.6	2000	2568.7	1.52	1.18
Yilma & Densa	barley	3.6	115	414	2000	2568.7	2.07	1.61
Arsi								
Bale Gesgar	Mixed wheat	10.72	101	1082.72	2000	2568.7	5.41	4.22
Diksis	Mixed Wheat	5.81	106	615.86	2000	2568.7	3.08	2.40
Hitosa	Mixed wheat	10.25	106	1086.5	2000	2568.7	5.43	4.23
Limu Bilbilo	Mixed wheat	3.79	106	401.74	2000	2568.7	2.01	1.56
Tena	Mixed wheat	5.45	106	577.7	2000	2568.7	2.89	2.25
E. Shoa								
Ad'a	Mixed Teff	4.32	202	872.64	2000	2568.7	4.36	3.40
Dugda	Red Teff	3.8	153	581.4	2000	2568.7	2.91	2.26
Liben Zequala	Mixed Teff	4.12	202	832.24	2000	2568.7	4.16	3.24
Shashemene	maize	7.85	66	518.1	2000	2568.7	2.59	2.02
E. Wollega								
Gida Kiramu	Mixed Teff	1.45	152	220.4	2000	2568.7	1.10	0.86
Jima Rarie	Mixed Teff	4.03	152	612.56	2000	2568.7	3.06	2.38
Sibu Sire	Maize	6.87	56	384.72	2000	2568.7	1.92	1.51
Jimma								
Dedo	Maize	3.21	52	166.92	2000	2568.7	0.83	0.65
Limu Kosa	Maize	6.51	52	338.52	2000	2568.7	1.69	1.32
Mana	Maize	7.97	52	414.44	2000	2568.7	2.07	1.61
Seka Chokorssa	Mixed Teff	3.85	145	558.25	2000	2568.7	2.79	2.17
N.W. Shoa								
Kuyu	Mixed Teff	5.35	155	829.25	2000	2568.7	4.15	3.23
Sululta	Mixed Teff	4.86	155	753.3	2000	2568.7	3.77	2.93
W. Shewa								
Ambo Zuria	Mixed Teff	2.86	155	443.3	2000	2568.7	2.22	1.73
Cheliya	Mixed Teff	2.7	155	418.5	2000	2568.7	2.09	1.63
Dendi	Mixed Teff	2.97	155	460.35	2000	2568.7	2.30	1.79
Welmera	Mixed Teff	1.94	155	300.7	2000	2568.7	1.50	1.17
Wenchi	Mixed Teff	3.64	155	564.2	2000	2568.7	2.82	2.20
S. People								
Guraghe								
Dalocha	Maize	11.54	64	738.56	2000	2568.7	3.69	2.88
Gumera	Barley	9.33	77	718.41	2000	2568.7	3.59	2.80
Izha & Welene	Barley	7.33	77	564.41	2000	2568.7	2.82	2.20
Hadiya								
Lemo	Mixed Wheat	6.89	105	723.45	2000	2568.7	3.62	2.82
Soro (Timbaro)	Mixed Teff	5.7	139	792.3	2000	2568.7	3.96	3.08
Kembata								
Alaba	Maize	7.67	64	490.88	2000	2568.7	2.45	1.91
Kacha Bira	Mixed Teff	5.56	139	772.84	2000	2568.7	3.86	3.01
North Omo								
Damote Gale	Maize	5.81	64	371.84	2000	2568.7	1.86	1.45
Kindo Koyisha	Maize	9.93	64	635.52	2000	2568.7	3.18	2.47
Sidama								
Aleta Wondo	Maize	7.15	66	471.9	2000	2568.7	2.36	1.84
Dale	Maize	9.32	66	615.12	2000	2568.7	3.08	2.39
shebedino	Maize	6.95	66	458.7	2000	2568.7	2.29	1.79

Note:1 Incremental Yield (unde farmers' management) from fertilizer use from KUAWAB/DSA Fertilizer Marketing Survey, 1995. The yield estimates are based on a group duscussion held with farmers in each site.

2. Out put prices are average prices for January - June 1996 obtained from Grain Market Research Project MIS unit

Annex II. Profitability of Fertilizer in Different Regions as Measured by the Value- Cost Ratio (VCR) With Deregulated and Unsubsidized Fertilizer Pricing , Cost Saving of 187.95 Birr/ton and Without Saving

Region	Most fret. crop of the area	Avr. Yld in Qt	Avg Produce price /qt during January-June in 96	Valueof increm. yield in Birr	Dereg DAP price/ton SC2	Dereg.DAP price SC 1	VCR 96 dereg.SC2	VCR 96 Deregu SC 1
S. Tigray								
Ambalagie	Mixed Wheat	2.68	215	576.2	2512.55	2700.5	2.29	2.13
Chercher	Mixed Teff	3.5	224	784	2512.55	2700.5	3.12	2.90
W. Tigray								
Lilay Keraro	Mixed Teff	3.1	224	694.4	2512.55	2700.5	2.76	2.57
E.Gojjam								
Guzamen	Red Teff	4.09	110	449.9	2459.69	2647.64	1.83	1.70
Mechakel	Red Teff	0.91	110	100.1	2459.69	2647.64	0.41	0.38
Shebel Bernta	Red Teff	4.37	110	480.7	2459.69	2647.64	1.95	1.82
N. Shoa								
Kaya Gabriel	Mixed Wheat	3.42	141	482.22	2400.65	2588.6	2.01	1.86
S.Gondar								
Dera	Millet	5.05	125	631.25	2590.55	2788.5	2.44	2.26
Iste	Red Teff	3.39	147	498.33	2590.55	2788.5	1.92	1.79
Kemkem	Red Teff	3.2	147	470.4	2590.55	2788.5	1.82	1.69
Simada	Red Teff	2	147	294	2590.55	2788.5	1.13	1.05
W. Gojjam								
Bahir Dar	Millet	3.83	80	306.4	2408.77	2596.72	1.27	1.18
Dembecha	Mixed Teff	3.14	114	357.96	2408.77	2596.72	1.49	1.38
Jabi Tahnan	maize	5.95	70	416.5	2408.77	2596.72	1.73	1.60
Quarit	Mixed Teff	2.3	132	303.6	2408.77	2596.72	1.26	1.17
Yilma & Densa	barley	3.6	115	414	2408.77	2596.72	1.72	1.59
Arsi								
Bale Gesgar	Mixed wheat	10.72	101	1082.72	2352.49	2540.44	4.60	4.26
Diksis	Mixed Wheat	5.81	106	615.86	2352.49	2540.44	2.62	2.42
Hitosa	Mixed wheat	10.25	106	1086.5	2352.49	2540.44	4.62	4.28
Limu Bilbilo	Mixed wheat	3.79	106	401.74	2352.49	2540.44	1.71	1.58
Tena	Mixed wheat	5.45	106	577.7	2352.49	2540.44	2.46	2.27
E. Shoa								
Ad'a	Mixed Teff	4.32	202	872.64	2335.07	2523.02	3.74	3.46
Dugda	Red Teff	3.8	153	581.4	2335.07	2523.02	2.49	2.30
Liben Zequala	Mixed Teff	4.12	202	832.24	2335.07	2523.02	3.56	3.30
Shashemene	maize	7.85	66	518.1	2394.36	2523.02	2.16	2.05
E. Wollega								
Gida Kiramu	Mixed Teff	1.45	152	220.4	2471.75	2659.7	0.89	0.83
Jima Rarie	Mixed Teff	4.03	152	612.56	2471.75	2659.7	2.48	2.30
Sibu Sire	Maize	6.87	56	384.72	2471.75	2659.7	1.56	1.45
Jimma								
Dedo	Maize	3.21	52	166.92	2474.43	2662.23	0.67	0.63
Limu Kosa	Maize	6.51	52	338.52	2474.43	2662.23	1.37	1.27
Mana	Maize	7.97	52	414.44	2474.43	2662.23	1.67	1.56
Seka Chokorssa	Mixed Teff	3.85	145	558.25	2474.43	2662.23	2.26	2.10
N.W. Shoa								
Kuyu	Mixed Teff	5.35	155	829.25	2359.52	2547.47	3.51	3.26
Sululta	Mixed Teff	4.86	155	753.3	2359.52	2547.47	3.19	2.96
W. Shewa								
Ambo Zuria	Mixed Teff	2.86	155	443.3	2400.73	2659.7	1.85	1.67
Cheliya	Mixed Teff	2.7	155	418.5	2400.73	2659.7	1.74	1.57
Dendi	Mixed Teff	2.97	155	460.35	2400.73	2659.7	1.92	1.73
Welmera	Mixed Teff	1.94	155	300.7	2400.73	2659.7	1.25	1.13
Wenchi	Mixed Teff	3.64	155	564.2	2400.73	2659.7	2.35	2.12
S. People								
Guraghe								
Dalocha	Maize	11.54	64	738.56	2412.45	2600.4	3.06	2.84
Gumera	Barley	9.33	77	718.41	2412.45	2600.4	2.98	2.76
Izha & Welene	Barley	7.33	77	564.41	2412.45	2600.4	2.34	2.17
Hadiya								
Lemo	Mixed Wheat	6.89	105	723.45	2437.24	2625.19	2.97	2.76
Soro (Timbaro)	Mixed Teff	5.7	139	792.3	2437.24	2625.19	3.25	3.02
Kembata								
Alaba	Maize	7.67	64	490.88	2439.92	2627.87	2.01	1.87
Kacha Bira	Mixed Teff	5.56	139	772.84	2439.92	2627.87	3.17	2.94
North Omo								
Damote Gale	Maize	5.81	64	371.84	2472.42	2660.37	1.50	1.40
Kindo Koyisha	Maize	9.93	64	635.52	2472.42	2660.37	2.57	2.39
Sidama								
Aleta Wondo	Maize	7.15	66	471.9	2394.36	2582.31	1.97	1.83
Dale	Maize	9.32	66	615.12	2394.36	2582.31	2.57	2.38
shebedino	Maize	6.95	66	458.7	2394.36	2582.31	1.92	1.78

Note: 1. Out put prices are average prices for January - June 1996 obtained from Grain Market Research Project MIS unit
2. Incremental Yield from fertilizer use from KUAWAB/DSA Fertilizer Marketing Survey, 1995.
3. 1996 fertilizer price from National Fertilizer Industry Agency (NFIA)

Annex III. Profitability of Fertilizer in Different Regions as Measured by the Value-Cost Ratio (VCR) With Unsubsidized 96 Price and With Reduced Marketing Margine by 10 Birr/Qt

Region	Most fret. crop of the area	Avr. incremental Yld in Qt	Average Produce price /qt during January-June in 96	Value of increm. yield in Birr	DAP/ton 96 unsubsidized	VCR 96 unsubs 10 B/q with improvmt	VCR 96 unsubs without improvmt
S. Tigray							
Ambalagie	Mixed Wheat	2.68	225	603	2568.7	2.35	2.24
Chercher	Mixed Teff	3.5	234	819	2568.7	3.19	3.05
W. Tigray							
Lilay Keraro	Mixed Teff	3.1	234	725.4	2568.7	2.82	2.70
E.Gojjam							
Guzamen	Red Teff	4.09	120	490.8	2568.7	1.91	1.75
Mechakel	Red Teff	0.91	120	109.2	2568.7	0.43	0.39
Shebel Bernta	Red Teff	4.37	120	524.4	2568.7	2.04	1.87
N. Shoa							
Kaya Gabriel	Mixed Wheat	3.42	151	516.42	2568.7	2.01	1.88
S.Gondar							
Dera	Millet	5.05	135	681.75	2568.7	2.65	2.46
Iste	Red Teff	3.39	157	532.23	2568.7	2.07	1.94
Kemkem	Red Teff	3.2	157	502.4	2568.7	1.96	1.83
Simada	Red Teff	2	157	314	2568.7	1.22	1.14
W. Gojjam							
Bahir Dar	Millet	3.83	90	344.7	2568.7	1.34	1.19
Dembecha	Mixed Teff	3.14	124	389.36	2568.7	1.52	1.39
Jabi Tahnan	maize	5.95	80	476	2568.7	1.85	1.62
Quarit	Mixed Teff	2.3	142	326.6	2568.7	1.27	1.18
Yilma & Densa	barley	3.6	125	450	2568.7	1.75	1.61
Arsi							
Bale Gesgar	Mixed wheat	10.72	111	1189.92	2568.7	4.63	4.22
Diksis	Mixed Wheat	5.81	116	673.96	2568.7	2.62	2.40
Hitosa	Mixed wheat	10.25	116	1189	2568.7	4.63	4.23
Limu Bilbilo	Mixed wheat	3.79	116	439.64	2568.7	1.71	1.56
Tena	Mixed wheat	5.45	116	632.2	2568.7	2.46	2.25
E. Shoa							
Ad'a	Mixed Teff	4.32	212	915.84	2568.7	3.57	3.40
Dugda	Red Teff	3.8	163	619.4	2568.7	2.41	2.26
Liben Zequala	Mixed Teff	4.12	212	873.44	2568.7	3.40	3.24
Shashemene	maize	7.85	76	596.6	2568.7	2.32	2.02
E. Wollega							
Gida Kiramu	Mixed Teff	1.45	162	234.9	2568.7	0.91	0.86
Jima Rarie	Mixed Teff	4.03	162	652.86	2568.7	2.54	2.38
Sibu Sire	Maize	6.87	66	453.42	2568.7	1.76	1.50
Jimma							
Dedo	Maize	3.21	62	199.02	2568.7	0.77	0.65
Limu Kosa	Maize	6.51	62	403.62	2568.7	1.57	1.32
Mana	Maize	7.97	62	494.14	2568.7	1.92	1.61
Seka Chokorssa	Mixed Teff	3.85	155	596.75	2568.7	2.32	2.17
N.W. Shoa							
Kuyu	Mixed Teff	5.35	165	882.75	2568.7	3.44	3.23
Sululta	Mixed Teff	4.86	165	801.9	2568.7	3.12	2.93
W. Shewa							
Ambo Zuria	Mixed Teff	2.86	165	471.9	2568.7	1.84	1.73
Cheliya	Mixed Teff	2.7	165	445.5	2568.7	1.73	1.63
Dendi	Mixed Teff	2.97	165	490.05	2568.7	1.91	1.79
Welmera	Mixed Teff	1.94	165	320.1	2568.7	1.25	1.17
Wenchi	Mixed Teff	3.64	165	600.6	2568.7	2.34	2.20
S. People							
Guraghe							
Dalocha	Maize	11.54	74	853.96	2568.7	3.32	2.88
Gumera	Barley	9.33	87	811.71	2568.7	3.16	2.80
Izha & Welene	Barley	7.33	87	637.71	2568.7	2.48	2.20
Hadiya							
Lemo	Mixed Wheat	6.89	115	792.35	2568.7	3.08	2.82
Soro (Timbaro)	Mixed Teff	5.7	149	849.3	2568.7	3.31	3.08
Kembata							
Alaba	Maize	7.67	74	567.58	2568.7	2.21	1.91
Kacha Bira	Mixed Teff	5.56	149	828.44	2568.7	3.23	3.01
North Omo							
Damote Gale	Maize	5.81	74	429.94	2568.7	1.67	1.45
Kindo Koyisha	Maize	9.93	74	734.82	2568.7	2.86	2.47
Sidama							
Aleta Wondo	Maize	7.15	76	543.4	2568.7	2.12	1.84
Dale	Maize	9.32	76	708.32	2568.7	2.76	2.39
shebedino	Maize	6.95	76	528.2	2568.7	2.06	1.79

Note: 1. Out put prices are average prices for January - June 1996 obtained from Grain Market Research Project MIS unit
2. Incremental Yield from fertilizer use from KUAWAB/DSA Fertilizer Marketing Survey, 1995.

Annex IV. Change in VCR Assuming Output Price Drop by 20 Percent from Jan- June 96 Average Price

Region	Most fret. crop of the area	Avr. incremental Yld in Qt	Average Produce price /qt during January-June in 96	Jan-Jun price less 20%	Value of increm. yield in Birr	DAP/ton 96 unsubsidized	VCR 96 unsusidized	VCR with 20% price drop
S. Tigray								
Ambalagie	Mixed Wheat	2.68	215	172	576.2	2568.7	2.24	1.79
Chercher	Mixed Teff	3.5	224	179.2	784	2568.7	3.05	2.44
W. Tigray								
Lilay Keraro	Mixed Teff	3.1	224	179.2	694.4	2568.7	2.70	2.16
E.Gojjam								
Guzamen	Red Teff	4.09	110	88	449.9	2568.7	1.75	1.40
Mechakel	Red Teff	0.91	110	88	100.1	2568.7	0.39	0.31
Shebel Bernta	Red Teff	4.37	110	88	480.7	2568.7	1.87	1.50
N. Shoa								
Kaya Gabriel	Mixed Wheat	3.42	141	112.8	482.22	2568.7	1.88	1.50
S.Gondar								
Dera	Millet	5.05	125	100	631.25	2568.7	2.46	1.97
Iste	Red Teff	3.39	147	117.6	498.33	2568.7	1.94	1.55
Kemkem	Red Teff	3.2	147	117.6	470.4	2568.7	1.83	1.47
Simada	Red Teff	2	147	117.6	294	2568.7	1.14	0.92
W. Gojjam								
Bahir Dar	Millet	3.83	80	64	306.4	2568.7	1.19	0.95
Dembecha	Mixed Teff	3.14	114	91.2	357.96	2568.7	1.39	1.11
Jabi Tahnan	maize	5.95	70	56	416.5	2568.7	1.62	1.30
Quarit	Mixed Teff	2.3	132	105.6	303.6	2568.7	1.18	0.95
Yilma & Densa	barley	3.6	115	92	414	2568.7	1.61	1.29
Arsi								
Bale Gesgar	Mixed wheat	10.72	101	80.8	1082.72	2568.7	4.22	3.37
Diksis	Mixed Wheat	5.81	106	84.8	615.86	2568.7	2.40	1.92
Hitosa	Mixed wheat	10.25	106	84.8	1086.5	2568.7	4.23	3.38
Limu Bilbilo	Mixed wheat	3.79	106	84.8	401.74	2568.7	1.56	1.25
Tena	Mixed wheat	5.45	106	84.8	577.7	2568.7	2.25	1.80
E. Shoa								
Ad'a	Mixed Teff	4.32	202	161.6	872.64	2568.7	3.40	2.72
Dugda	Red Teff	3.8	153	122.4	581.4	2568.7	2.26	1.81
Liben Zequala	Mixed Teff	4.12	202	161.6	832.24	2568.7	3.24	2.59
Shashemene	maize	7.85	66	52.8	518.1	2568.7	2.02	1.61
E. Wollega								
Gida Kiramu	Mixed Teff	1.45	152	121.6	220.4	2568.7	0.86	0.69
Jima Rarie	Mixed Teff	4.03	152	121.6	612.56	2568.7	2.38	1.91
Sibu Sire	Maize	6.87	56	44.8	384.72	2568.7	1.50	1.20
Jimma								
Dedo	Maize	3.21	52	41.6	166.92	2568.7	0.65	0.52
Limu Kosa	Maize	6.51	52	41.6	338.52	2568.7	1.32	1.05
Mana	Maize	7.97	52	41.6	414.44	2568.7	1.61	1.29
Seka Chokorssa	Mixed Teff	3.85	145	116	558.25	2568.7	2.17	1.74
N.W. Shoa								
Kuyu	Mixed Teff	5.35	155	124	829.25	2568.7	3.23	2.58
Sululta	Mixed Teff	4.86	155	124	753.3	2568.7	2.93	2.35
W. Shewa								
Ambo Zuria	Mixed Teff	2.86	155	124	443.3	2568.7	1.73	1.38
Cheliya	Mixed Teff	2.7	155	124	418.5	2568.7	1.63	1.30
Dendi	Mixed Teff	2.97	155	124	460.35	2568.7	1.79	1.43
Welmera	Mixed Teff	1.94	155	124	300.7	2568.7	1.17	0.94
Wenchi	Mixed Teff	3.64	155	124	564.2	2568.7	2.20	1.76
S. People								
Guraghe								
Dalocha	Maize	11.54	64	51.2	738.56	2568.7	2.88	2.30
Gumera	Barley	9.33	77	61.6	718.41	2568.7	2.80	2.24
Izha & Welene	Barley	7.33	77	61.6	564.41	2568.7	2.20	1.76
Hadiya								
Lemo	Mixed Wheat	6.89	105	84	723.45	2568.7	2.82	2.25
Soro (Timbaro)	Mixed Teff	5.7	139	111.2	792.3	2568.7	3.08	2.47
Kembata								
Alaba	Maize	7.67	64	51.2	490.88	2568.7	1.91	1.53
Kacha Bira	Mixed Teff	5.56	139	111.2	772.84	2568.7	3.01	2.41
North Omo								
Damote Gale	Maize	5.81	64	51.2	371.84	2568.7	1.45	1.16
Kindo Koyisha	Maize	9.93	64	51.2	635.52	2568.7	2.47	1.98
Sidama								
Aleta Wondo	Maize	7.15	66	52.8	471.9	2568.7	1.84	1.47
Dale	Maize	9.32	66	52.8	615.12	2568.7	2.39	1.92
shebedino	Maize	6.95	66	52.8	458.7	2568.7	1.79	1.43

Note: 1. Out put prices are average prices for January - June 1996 obtained from Grain Market Research Project MIS unit
2. Incremental Yield from fertilizer use from KUAWAB/DSA Fertilizer Marketing Survey, 1995.
3. 1996 fertilizer price from National Fertilizer Industry Agency (NFIA)

Annex V. Change in Fertilizer Profitability (VCR) Assuming Crop Response to Fertilizer Improves by 20 Percent

Region	Most fret. crop of the area	Avr. incremental Yld in Qt	Increased response by 20 %	Average Produce price /qt during January-June in 96	Value of increm. yield in Birr	DAP/ton 96 unsubsidized	VCR 96 unsusidized	VCR 96 unsubsid 20% incresed resp
S. Tigray								
Ambalagie	Mixed Wheat	2.68	3.216	215	691.44	2568.7	2.24	2.69
Chercher	Mixed Teff	3.5	4.2	224	940.8	2568.7	3.05	3.66
W. Tigray								
Lilay Keraro	Mixed Teff	3.1	3.72	224	833.28	2568.7	2.70	3.24
E.Gojjam								
Guzamen	Red Teff	4.09	4.908	110	539.88	2568.7	1.75	2.10
Mechakel	Red Teff	0.91	1.092	110	120.12	2568.7	0.39	0.47
Shebel Bernta	Red Teff	4.37	5.244	110	576.84	2568.7	1.87	2.25
N. Shoa								
Kaya Gabriel	Mixed Wheat	3.42	4.104	141	578.664	2568.7	1.88	2.25
S.Gondar								
Dera	Millet	5.05	6.06	125	757.5	2568.7	2.46	2.95
Iste	Red Teff	3.39	4.068	147	597.996	2568.7	1.94	2.33
Kemkem	Red Teff	3.2	3.84	147	564.48	2568.7	1.83	2.20
Simada	Red Teff	2	2.4	147	352.8	2568.7	1.14	1.37
W. Gojjam								
Bahir Dar	Millet	3.83	4.596	80	367.68	2568.7	1.19	1.43
Dembecha	Mixed Teff	3.14	3.768	114	429.552	2568.7	1.39	1.67
Jabi Tahnan	maize	5.95	7.14	70	499.8	2568.7	1.62	1.95
Quarit	Mixed Teff	2.3	2.76	132	364.32	2568.7	1.18	1.42
Yilma & Densa	barley	3.6	4.32	115	496.8	2568.7	1.61	1.93
Arsi								
Bale Gesgar	Mixed wheat	10.72	12.864	101	1299.264	2568.7	4.22	5.06
Diksis	Mixed Wheat	5.81	6.972	106	739.032	2568.7	2.40	2.88
Hitosa	Mixed wheat	10.25	12.3	106	1303.8	2568.7	4.23	5.08
Limu Bilbilo	Mixed wheat	3.79	4.548	106	482.088	2568.7	1.56	1.88
Tena	Mixed wheat	5.45	6.54	106	693.24	2568.7	2.25	2.70
E. Shoa								
Ad'a	Mixed Teff	4.32	5.184	202	1047.168	2568.7	3.40	4.08
Dugda	Red Teff	3.8	4.56	153	697.68	2568.7	2.26	2.72
Liben Zequala	Mixed Teff	4.12	4.944	202	998.688	2568.7	3.24	3.89
Shashemene	maize	7.85	9.42	66	621.72	2568.7	2.02	2.42
E. Wollega								
Gida Kiramu	Mixed Teff	1.45	1.74	152	264.48	2568.7	0.86	1.03
Jima Rarie	Mixed Teff	4.03	4.836	152	735.072	2568.7	2.38	2.86
Sibu Sire	Maize	6.87	8.244	56	461.664	2568.7	1.50	1.80
Jimma								
Dedo	Maize	3.21	3.852	52	200.304	2568.7	0.65	0.78
Limu Kosa	Maize	6.51	7.812	52	406.224	2568.7	1.32	1.58
Mana	Maize	7.97	9.564	52	497.328	2568.7	1.61	1.94
Seka Chokorssa	Mixed Teff	3.85	4.62	145	669.9	2568.7	2.17	2.61
N.W. Shoa								
Kuyu	Mixed Teff	5.35	6.42	155	995.1	2568.7	3.23	3.87
Sululta	Mixed Teff	4.86	5.832	155	903.96	2568.7	2.93	3.52
W. Shewa								
Ambo Zuria	Mixed Teff	2.86	3.432	155	531.96	2568.7	1.73	2.07
Cheliya	Mixed Teff	2.7	3.24	155	502.2	2568.7	1.63	1.96
Dendi	Mixed Teff	2.97	3.564	155	552.42	2568.7	1.79	2.15
Welmera	Mixed Teff	1.94	2.328	155	360.84	2568.7	1.17	1.40
Wenchi	Mixed Teff	3.64	4.368	155	677.04	2568.7	2.20	2.64
S. People								
Guraghe								
Dalocha	Maize	11.54	13.848	64	886.272	2568.7	2.88	3.45
Gumera	Barley	9.33	11.196	77	862.092	2568.7	2.80	3.36
Izha & Welene	Barley	7.33	8.796	77	677.292	2568.7	2.20	2.64
Hadiya								
Lemo	Mixed Wheat	6.89	8.268	105	868.14	2568.7	2.82	3.38
Soro (Timbaro)	Mixed Teff	5.7	6.84	139	950.76	2568.7	3.08	3.70
Kembata								
Alaba	Maize	7.67	9.204	64	589.056	2568.7	1.91	2.29
Kacha Bira	Mixed Teff	5.56	6.672	139	927.408	2568.7	3.01	3.61
North Omo								
Damote Gale	Maize	5.81	6.972	64	446.208	2568.7	1.45	1.74
Kindo Koyisha	Maize	9.93	11.916	64	762.624	2568.7	2.47	2.97
Sidama								
Aleta Wondo	Maize	7.15	8.58	66	566.28	2568.7	1.84	2.20
Dale	Maize	9.32	11.184	66	738.144	2568.7	2.39	2.87
shebedino	Maize	6.95	8.34	66	550.44	2568.7	1.79	2.14

Note: 1. Out put prices are average prices for January - June 1996 obtained from Grain Market Research Project MIS unit
2. Incremental Yield from fertilizer use from KUAWAB/DSA Fertilizer Marketing Survey, 1995.
3. 1996 fertilizer price from National Fertilizer Industry Agency (NFIA)

Annex VI. Fertilizer Profitability Under Improved Marketing of Inputs, Outputs and With Improved Crop Response

Region	Most fret. crop of the area	Increased response by 20 %	Price after reducing margin by 10 B/qt	Value of Incre m yield	Dereg DAP price/ton SC5	VCR unsubsidized With all Imprvments	VCR 96 unsubsidized No improvement
S. Tigray							
Ambalagie	Mixed Wheat	3.22	225	723.6	2512.55	2.88	2.24
Chercher	Mixed Teff	4.20	234	982.8	2512.55	3.91	3.05
W. Tigray							
Lilay Keraro	Mixed Teff	3.72	234	870.48	2512.55	3.46	2.70
E.Gojjam							
Guzamen	Red Teff	4.91	120	588.96	2459.69	2.39	1.75
Mechakel	Red Teff	1.09	120	131.04	2459.69	0.53	0.39
Shebel Bernta	Red Teff	5.24	120	629.28	2459.69	2.56	1.87
N. Shoa							
Kaya Gabriel	Mixed Wheat	4.10	151	619.704	2400.65	2.58	1.88
S.Gondar							
Dera	Millet	6.06	135	818.1	2590.55	3.16	2.46
Iste	Red Teff	4.07	157	638.676	2590.55	2.47	1.94
Kemkem	Red Teff	3.84	157	602.88	2590.55	2.33	1.83
Simada	Red Teff	2.40	157	376.8	2590.55	1.45	1.14
W. Gojjam							
Bahir Dar	Millet	4.60	90	413.64	2408.77	1.72	1.19
Dembecha	Mixed Teff	3.77	124	467.232	2408.77	1.94	1.39
Jabi Tahnan	maize	7.14	80	571.2	2408.77	2.37	1.62
Quarit	Mixed Teff	2.76	142	391.92	2408.77	1.63	1.18
Yilma & Densa	barley	4.32	125	540	2408.77	2.24	1.61
Arsi							
Bale Gesgar	Mixed wheat	12.86	111	1427.904	2352.49	6.07	4.22
Diksis	Mixed Wheat	6.97	116	808.752	2352.49	3.44	2.40
Hitosa	Mixed wheat	12.30	116	1426.8	2352.49	6.07	4.23
Limu Bilbilo	Mixed wheat	4.55	116	527.568	2352.49	2.24	1.56
Tena	Mixed wheat	6.54	116	758.64	2352.49	3.22	2.25
E. Shoa							
Ad'a	Mixed Teff	5.18	212	1099.008	2335.07	4.71	3.40
Dugda	Red Teff	4.56	163	743.28	2335.07	3.18	2.26
Liben Zequala	Mixed Teff	4.94	212	1048.128	2335.07	4.49	3.24
Shashemene	maize	9.42	76	715.92	2394.36	2.99	2.02
E. Wollega							
Gida Kiramu	Mixed Teff	1.74	162	281.88	2471.75	1.14	0.86
Jima Rarie	Mixed Teff	4.84	162	783.432	2471.75	3.17	2.38
Sibu Sire	Maize	8.24	66	544.104	2471.75	2.20	1.50
Jimma							
Dedo	Maize	3.85	62	238.824	2474.43	0.97	0.65
Limu Kosa	Maize	7.81	62	484.344	2474.43	1.96	1.32
Mana	Maize	9.56	62	592.968	2474.43	2.40	1.61
Seka Chokorssa	Mixed Teff	4.62	155	716.1	2474.43	2.89	2.17
N.W. Shoa							
Kuyu	Mixed Teff	6.42	165	1059.3	2359.52	4.49	3.23
Sululta	Mixed Teff	5.83	165	962.28	2359.52	4.08	2.93
W. Shewa							
Ambo Zuria	Mixed Teff	3.43	165	566.28	2400.73	2.36	1.73
Cheliya	Mixed Teff	3.24	165	534.6	2400.73	2.23	1.63
Dendi	Mixed Teff	3.56	165	588.06	2400.73	2.45	1.79
Welmera	Mixed Teff	2.33	165	384.12	2400.73	1.60	1.17
Wenchi	Mixed Teff	4.37	165	720.72	2400.73	3.00	2.20
S. People							
Guraghe							
Dalocha	Maize	13.85	74	1024.752	2412.45	4.25	2.88
Gumera	Barley	11.20	87	974.052	2412.45	4.04	2.80
Izha & Welene	Barley	8.80	87	765.252	2412.45	3.17	2.20
Hadiya							
Lemo	Mixed Wheat	8.27	115	950.82	2437.24	3.90	2.82
Soro (Timbaro)	Mixed Teff	6.84	149	1019.16	2437.24	4.18	3.08
Kembata							
Alaba	Maize	9.20	74	681.096	2439.92	2.79	1.91
Kacha Bira	Mixed Teff	6.67	149	994.128	2439.92	4.07	3.01
North Omo							
Damote Gale	Maize	6.97	74	515.928	2472.42	2.09	1.45
Kindo Koyisha	Maize	11.92	74	881.784	2472.42	3.57	2.47
Sidama							
Aleta Wondo	Maize	8.58	76	652.08	2394.36	2.72	1.84
Dale	Maize	11.18	76	849.984	2394.36	3.55	2.39
shebedino	Maize	8.34	76	633.84	2394.36	2.65	1.79