

CONSTRAINTS TO INCREASING WHEAT PRODUCTION IN ETHIOPIA'S SMALL-HOLDER SECTOR

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Abstract

Ethiopia is sub-Saharan Africa's largest producer of wheat. Small-holders produce 76% of the total production; producer cooperatives and state farms account for the rest. The growth in wheat consumption has exceeded production growth in recent years, leading to huge deficits. Since land for expanding production is limiting, production increases in future years will depend on increasing yields per hectare. In the small-holder sector, yields are low and there is considerable potential for increasing them. The principal socio-economic constraints to increasing wheat production are the unavailability of improved seeds and fertilizers, low fixed wheat prices, shortages of labor and land, and lack of draft power and credit. Principal technical constraints include low soil fertility, weeds, diseases, and the low potential of existing durum wheat varieties. Sustained efforts are therefore needed to develop and disseminate technologies that are appropriate and profitable for small farmers in order to solve these problems.

Introduction and Background

Ethiopia is sub-Saharan Africa's second most populous nation, with a population of 47 million, estimated to be growing at 2.9 per cent per year. If the present trend continues, by the year 2000 Ethiopia will have a population of 65 to 67 million people. Agriculture is the mainstay of the economy, accounting for 90% of export earnings, 85% of employment, and 50% of gross domestic product (6).

While Ethiopia has an abundance of fertile land and substantial agricultural potential, its food deficit has been increasing over the past 30 years. From 1965 to 1980, the agricultural sector grew at an average annual rate of 1.2%, while the population grew at 2.7% per year. From 1980 to 1986, the value of agricultural production actually declined (16), partly as a result of the devastating drought of 1984. Government policy currently gives great weight to achieving self-sufficiency in food production, and wheat is one of the three cereals selected to receive priority for increasing production.

This paper examines wheat production in Ethiopia, focussing on the small-holder sector, which accounts for 76% of total wheat production. First, the role of wheat in the Ethiopian economy is outlined and production trends are assessed. Next production practices, marketing and utilization are discussed. Finally, constraints to increasing production are presented.

Role of Wheat in Ethiopia

Ethiopia is sub-Saharan Africa's largest producer of wheat accounting for over half of total wheat area in the region (Table 1). However, as Table 1 shows, Ethiopia's wheat yields are much lower than those of most other African countries. This is partly explained by the fact that wheat is a traditional crop in Ethiopia grown using traditional practices whereas in most other countries, it is of recent introduction and is grown using improved technology.

Table 2 shows that wheat ranks fifth in area and production and fourth in yield among Ethiopia's principal cereals.

The most important wheat growing areas of Ethiopia are the highlands of the central, southeastern, and northwestern regions of the country. Wheat is found at altitudes ranging from 1700 to 2900 masl rainfall in these areas is bimodal and varies from 600 to 2000 mm. Most wheat is produced during the main rainy season, June to September, although some is produced during the light rain season, March to May. Virtually all wheat is produced under rainfed conditions.

The two major wheat species grown in Ethiopia are durum wheat (*Triticum durum* L.) and bread wheat (*Triticum aestivum* L.). Durum wheat is indigenous and Ethiopia is considered to be one of the centers of genetic diversity. Bread wheat has been introduced relatively recently. Durum wheat accounts for two-thirds of the country's total wheat area (15).

Production Structure and Trends

Wheat is grown by three types of farms in Ethiopia, that is, small-holders, state farms, and producer cooperatives (collective farms). Small-holders farm 82% of the total wheat area, producing 76% of the total wheat harvest (Table 3). State farms account for 10% of the area and 17% of wheat production and produce only bread wheat. Producer cooperatives account for 8% of wheat area and 7% of production. Yields average about 2.0 t/ha for state farms and 1.1 t/ha for small-holder and producer cooperatives.

Table 4 summarizes trends in wheat area, production, and yields over the 37 year period from 1948-50 to 1985-87. From 1948-50 to 1961-63, both area and yields increased, resulting in increased production. Over the period 1961-63 to 1979-81, there were declines in wheat area and production. However, wheat yields increased; these were mostly caused by the rapid increase in cultivation by state farms, which use a higher level of technology, and, thus, achieve higher yields. Over the period 1979-81 to 1985-87, wheat area and yields increased, resulting in a 3.58% annual growth rate in production. These increases were also largely attributable to increases in area and yield on the state farms.

Per capita wheat consumption stagnated over the period 1961-63 to 1979-81, and then increased dramatically in the 1980s (Table 5). The big increase in wheat consumption has been as a result of food aid during and following the 1984 famine and subsidized bread prices as well as the high population growth rate. Whereas Ethiopia had been self-sufficient in wheat production in the 1960s, by 1985-1987, the country was producing only half of the total wheat consumed. Total imports amounted to over 700,000 t, about 85% of which was received as food aid. These trends point to the dramatic need to increase wheat production to reduce Ethiopia's food deficit.

Wheat in the Small-Holder Farming System

Production practices

Information on farmers' production practices in this section are taken from Hailu and Mohammed (12), Alemayehu and Franzel (1), Hailu and Chilot (11), and Chilot *et al.*, (4). Table 6 shows the importance of wheat in five selected small-holder wheat growing areas. In four of the five areas

shown, wheat is primarily grown for food; in the Sinana area its primary role is as a cash crop. Table 6 shows that in the five areas, wheat is grown by over 85% of the farmers and occupies 24% to 39% of the cultivated area. Average wheat area per farm ranges from 0.71 ha to 1.0 ha.

Wheat production practices vary from location to location as shown in Table 7. In most wheat areas, wheat is planted only once per year at the onset of the main rainy season. In some areas, such as Sinana, wheat is also planted during the short rainy season, using a different field than that used for main season wheat.

For main season wheat, land preparation commences at the onset of the rains, which varies between January and April. The main reason for not starting earlier is that the soil is too hard to plow with the local plow, "maresha", which is made from wood and has a metal blade for breaking the soil. In most areas, a pair of oxen are used for land preparation; however, in Inewari, horses are also used. The number of plowings depend on the onset of the rains, the strength of draft power, and nature of the soil. Wheat fields are plowed on average two to five times before planting.

The time of planting ranges from mid-June to August, depending on the varieties used, the soil type, and the level of rainfall. For example, in the Holetta area on red soils, wheat is planted in June. In Inewari and Aleltu-Sendafa, where soils are black and prone to waterlogging, wheat is planted in August. Research shows that optimum planting dates vary across areas and that late planting tends to reduce yields by as much as 34% (10).

In most areas, wheat is planted on flat soil. However, in Inewari, farmers make broadbeds and furrows by hand and at Aleltu-Sendafa planting is done on ridges which are constructed by ox-plow. Both of these methods are used to partially remedy the waterlogging problem.

Planting is done by broadcasting seed; seed is then covered by animal-drawn plows. Most farmers use local varieties; those who use improved varieties tend to allocate a portion of their field for local varieties as a risk avoiding measure.

Table 8 shows that the percentage of wheat area planted to semidwarf varieties in Ethiopia is very low relative to other countries in Eastern and Southern Africa (5).

The percentage of farmers using fertilizer ranges from 10% to 100% depending on the area. The most common fertilizer used is diammonium phosphate (18-46 N-P₂O₅); farmers' rates of application range from 50 to 125 kg/ha (9-23 N-P₂O₅ to 23-58 N-P₂O₅ kg/ha); recommended rates are 60-60 N-P₂O₅. Farmers' fertilizer rates depend on the availability of fertilizer and the fertility of the soil. The quantity of fertilizer supplied to farmers is generally less than the supply they are willing to purchase. Fertilizer use in wheat production is very low relative to other countries. For instance, in 1985, on average only 11 kg nutrients/ha were used in Ethiopia compared to Zimbabwe's 279 kg nutrients/ha (5). Manure is not used because fields tend to be far from the homesteads and because priority for manure use is given to other crops.

Wheat tends to be weeded later than is recommended, either because of an overlapping of activities during the appropriate weeding time (Holetta) or because farmers need weeds for livestock feed (Inewari). Most farmers in Aleltu-Sendafa and Sinana do not weed at all; they claim that it is not necessary and that they lack time. Many farmers in Holetta and Kulumsa area use herbicides (2,4-D) to control broadleaf weeds; they remove grass weeds by hand.

The time of harvesting main season wheat varies between November and February, depending on the sowing date and the type of variety used (early versus late maturing). Harvesting is done manually using a sickle. Harvested wheat is piled and threshing begins once all the wheat and other crops are harvested. Threshing is done by using animals, mainly oxen, to trample the grain on a small threshing ground, a hard surface made of sun-dried dung and soil.

Marketing and utilization

Most small-holders grow wheat primarily for food; surplus production above household needs is sold. Farmers store wheat in local stores made of mud and plant material plastered with cow dung. These stores may be kept in the house or outdoors. Rodents were reported to be a problem in Holetta and Kulumsa; weevils damage wheat in Holetta.

Rural households use wheat for preparation of local bread (dabbo), boiled grain (nifro), roasted grain (kolo), porridge (genfo), or as a component of injera. Wheat straw is used for roof covering and for animal feed although it is said to be inferior to straws of other major cereals. In urban areas, wheat bread prepared in bakeries is sold at subsidized prices and is a popular snack food. Urban dwellers also consume home-made bread as a breakfast food.

Farmers sell their wheat through three channels: service cooperatives (SCs), private traders and consumers. In many areas, farmers are required to deliver a quota of wheat to their SCs. SCs then sell the grain to the Agricultural Marketing Corporation (AMC) which distributes the grain to consumers, bakers, and state organizations. Typical quotas are 100 to 200 kg and farmers are paid for the quotas at official prices which are fixed and uniform throughout the country and over seasons. These official prices are usually below local market prices, which vary according to supply and demand. For example, at six markets over the period 1985-1987, local wheat prices on average were 2.3 times higher than the fixed official prices (Relief and Rehabilitation Commission, price data, unpublished).

Quotas are set at the national level and then distributed at different administrative levels: regional, district (awraja), and sub-district (wereda). The weredas distribute their quotas to SCs and SCs in turn give quotas to PAs. Finally, PAs distribute their quotas to farmers. At the PA level, quotas are fixed on the basis of farmer wealth using such indicators as area cultivated, number of oxen owned and off-farm income. In the first years, quota implementation was a directive from the top and was based on national needs. Since 1985, however, a degree of flexibility and feedback from the local level has been introduced in the assessment and distribution of quotas (9).

Farmers also sell wheat to private traders and consumers at local market prices. Until 1988, the private grain trade was banned in Arsi and strictly controlled in other wheat producing areas. In 1988, private traders were permitted to buy, transport, and sell grain as long as they sold half of their purchases to the AMC at fixed official prices. There were reports from Arsi in 1988 that significant quantities of wheat were moving through private marketing channels to Addis Ababa.

Improved inputs such as improved seed and fertilizer are distributed to farmers through their service cooperatives. They are not generally available in the parallel markets. On the other hand, herbicides are not generally available through the SCs, but are available in limited quantities in the parallel markets at inflated prices.

Constraints to Increasing Production

Principal constraints to increasing production are categorized into two groups, technical and socioeconomic. The constraints are not listed in order of importance since the ranking of problems varies from area to area.

Technical constraints

Low soil fertility--Low soil fertility has been noted as a major problem in four of the five areas; it is a secondary problem in Sinana, where cultivation has begun relatively recently. Fertility problems are also aggravated by farmers' cultivation practices. In all five areas, farmers practice continuous cultivation; land is not fallowed. In Sinana, cereals account for about 90% of the cultivated area; thus, there is almost no rotation with oilseed crops or pulses. Pulses and oilseed crops are more

common in Holetta, and crop rotations are common. On-farm wheat fertilizer trials in the Kulumsa, Adet and Sinana areas have established the profitability of fertilizer (8).

Weeds--Weeds are reported to be a major problem in Holetta and Kulumsa. Weed damage is aggravated by an overlapping of activities at the time of weeding; for example, in Holetta during wheat weeding in August, farmers are also preparing land for planting tef. The optimum period for weeding is the farmers' busiest time of the year in both Holetta and Kulumsa. As a result, farmers are often unable to effectively control weeds. It should be noted that in areas where farmers do not weed wheat, weeds may not be a problem in wheat. For example, preliminary data from weed control experiments on wheat in the Sinana area during the main rainy season indicate that weeding wheat is not economic there (7).

Pests and Diseases--Stem and leaf rust are the principal disease problems on durum wheat; principal diseases affecting bread wheat are stripe rust and *Septoria tritici* (van Ginkel, per. comm.). Rusts were reported to be an important problem in the Kulumsa and Holetta areas. In the Holetta area in 1985, 53% of the farmers reported the problem. Aphids are the principal insect problem on wheat; aphids are a high priority problem in Sinana, especially during the main season. The problem is aggravated by late planting; late-planted wheat is more susceptible to moisture stress and thus aphid attack (1). Seed gall nematode is a major problem in Kulumsa. Wild animals are also an important problem affecting wheat in Holetta. The principal problem there is wild pigs, which feed on awnless wheat.

Varieties--Many of the local durum wheat varieties have low yield potential, tending to be weak-strawed; they have low resistance to diseases and lodging (15).

Other constraints--Other constraints of medium importance or specific to selected areas include:

- Poor seedbed preparation is largely a result of the shortage of oxen, weak oxen, the dry season feed shortage, and poor performing plows. Poor seedbed preparation results in thin crop stands and leads to severe weed infestation.
- Waterlogging of soils is an important problem on Vertisols at Inewari and Aleltu-Sendafa. Because of this problem, farmers are forced to plant late, nutrients are leached from the soil, and yields are reduced.
- Climatic problems also affect wheat production. Rainfall distribution is often poor in Sinana and frost may injure wheat in Sinana and Holetta.

Socioeconomic constraints

Unavailability of improved inputs--Research has shown that use of improved seeds, fertilizers, and herbicides can increase wheat production. Farmers have shown great interest in using such inputs. However, state farms and producer cooperatives receive priority in the allocation of improved inputs; in the small-holder sector, these inputs are not available in sufficient quantities to meet the demand. Furthermore, prices of some inputs such as improved seed are too high for farmers to afford. For example, improved wheat seed sells for 86 birr per 100 kg whereas the official price farmers receive for wheat is only 35 birr per 100 kg.

Seasonal labor shortages--In most of the highlands, most crops are planted at the same time. This results in shortages of labor during the peak seasons of weeding and harvesting. The most important crop in many wheat growing areas, tef, is usually planted about 1 month later than wheat. Important labor overlaps between the two crops still occur; the weeding time for wheat coincides with land preparation and planting of tef. As a result, wheat is weeded late. The harvesting labor bottleneck is especially problematic because some varieties are prone to shattering; if harvesting is delayed, late rainfall may damage the crop.

Draft power shortage--Because of the shortage of draft power, land preparation is often poor and is not completed on time. This problem is exacerbated by unavailability of dry season feed which causes the oxen to be very weak. Poorly prepared land leads to poor plant establishment, high weed infestation and low yields.

Land shortages--The shortage of land limits wheat production, especially in Inewari, Holetta and Kulumsa. At the latter two sites, it is also aggravated by the expansion of producer cooperatives, which are allocated land from small-holder areas.

Low prices--Low fixed prices are also an important constraint. At six locations over the period 1985-1987, local wheat prices were on average 2.7 times higher than the fixed, official prices (9). Low official prices have two important effects on production. First, they reduce farm income, reducing farmers' ability to invest in their farms. Second, they discourage the use of improved inputs such as fertilizer and improved seed. For example, data from on-farm fertilizer trials on major crops show that at fixed official prices fertilizer is profitable at only 43% of the 28 sites where trials were conducted. Using local market prices, fertilizer became profitable at 79% of the sites (9). It is likely that raising wheat prices would encourage the use of improved inputs and facilitate increased production.

Lack of credit--Lack of access to credit is also an important constraint to increased wheat production. Credit for purchasing fertilizer is available but is inadequate. The Agricultural and Industrial Development Bank (AIDB) extends credit for fertilizer to farmers through their service cooperatives. Nearly all fertilizer supplied to small farmers is sold on credit in this manner. However, if less than 95% of a PA's fertilizer debt is repaid then credit is not extended to any farmer in the PA the following year (13). AIDB also makes loans to individual farmers but the supply is extremely small since most agricultural credit is allocated to state farms and producer cooperatives.

Conclusions

Recent trends show that the growth rate of wheat consumption in Ethiopia has far exceeded the growth rate in production. Given the high demand for wheat and the high rate of growth in population, Ethiopia's wheat deficit will continue to be large in future years. There is very little land left in the highlands for extending the area cultivated. Therefore, increases in wheat production will have to come from intensifying cultivation, that is, increasing yields.

There is great potential for increasing yields in the small-holder sector, which accounts for 76% of production. Results from on farm trials have shown high response to improved inputs, especially improved varieties and fertilizers. However, these inputs are not available in sufficient quantities or when needed. Furthermore, low official wheat prices often cause improved inputs to be unprofitable.

Principal technical constraints to increasing wheat production include low soil fertility, weeds, diseases, and the low potential of existing durum wheat varieties. Chemical fertilizers, though expensive, show high returns at the farm level. Herbicides have great potential for controlling weeds, alleviating labor shortages, reducing the cost of weed control, and increasing yields. Improved varieties are needed which resist disease, respond better to improved inputs, and which are acceptable to farmers. A sustained effort is therefore needed to develop technologies that are appropriate and profitable for small farmers in order to solve these problems.

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Table 1. Wheat area and yields in Ethiopia and selected countries in Eastern and Southern Africa, 1983-1987.

	Wheat area 1983-87 (million ha)	Wheat yield 1983-87 (t/ha)
ETHIOPIA	0.61	1.24
KENYA	0.12	1.90
TANZANIA	0.05	1.46
SUDAN	0.12	1.26
ZIMBABWE	0.03	5.55
SUB-SAHARAN AFRICA	1.06	1.46
DEVELOPING COUNTRIES	99.82	2.09

Source: CIMMYT and FAO Tapes.

Table 2. Average area, yield and production of major cereals, 1979-1986.

Crop	Area		Production		Yield	
	('000 ha)	Rank	('000 t)	Rank	(t/ha)	Rank
Tef	1355	1	1150	2	0.85	5
Sorghum	882	2	1149	3	1.30	2
Barley	864	3	974	4	1.13	3
Maize	840	4	1331	1	1.58	1
Wheat	644	5	708	5	1.10	4

Source: (2).

Table 3. Wheat area, production and yield by farm type, main season, 1986/87.^a

Sector	Area ('000 ha)		Production ('000 t)		Yield (t/ha)
Smallholders	526.49	(82.4) ^b	585.224	(76.3)	1.11
Producer Cooperatives	49.30	(7.7)	53.130	(6.9)	1.08
State farms	63.15	(9.9)	129.130	(16.8)	2.04
Total	638.94	(100.0)	767.484	(100.0)	

Source: (3).

^a Main season wheat production accounts for 99% of total wheat production.

^b Figures in parentheses are percentages.

Table 4. Growth rates in wheat area, production and yield in Ethiopia (%).

Period	Area ('000 ha)	Production ('000 t)	Yield (t/ha)
1948-50 to 1961-63	0.67	2.34	1.67
1961-63 to 1970-72	-1.38	0.31	1.69
1970-72 to 1979-81	-3.43	-0.56	2.87
1979-81 to 1985-87	0.72	3.58	2.86
1948-50 to 1985-87	-0.89	2.61	3.50

Source: CIMMYT and FAO Tapes.

Table 5. Wheat consumption, self-sufficiency and food aid in Ethiopia.

Period	Total wheat consumed ('000 t)	Per capita wheat consumption (kg)	Growth rate per capita wheat consumption (%/yr) ^a	Self sufficiency (%)	% of wheat imports received as food aid
1961-63	644	25	-	99	-
1970-72	699	22	-1.30	94	85 ^b
1979-81	879	23	0.23	71	-
1985-87	1500	33	5.47	53	85 ^c
1961-63 to 1985-87	-	-	1.10	-	-

Source: CIMMYT and FAO Tapes.

^a Figures show the growth rate in per capita wheat consumption compared to the previous period.

^b For the years 1972-76.

^c For the years 1983-87

Table 6. Importance of wheat in selected wheat growing areas of Ethiopia.

Region	Area	Major Crops (in order of importance by area) ^a	% of farmers growing wheat	Total area cultivated per farm (ha)	Wheat area per farm (ha)	% of wheat area
Shewa	Holetta	T, W, B, F	85	2.61	0.71	27
Shewa	Inewari	W, T, F, L	100	2.16	0.71	33
Shewa	Aleltu-Sendafa	W, T, C, L	100	3.44	0.81	24
Arsi	Kulumse	B, W, P, F	93	2.20	0.86	39
Bale	Sinana	B, W, P	85	4.0	1.0	25

Source: Various diagnostic survey reports.

^a W = Wheat, F = Fababean, C = Chickpea, B = Barley, T = Tef P = Fieldpea, L = Lentil.

Table 7. Wheat production practices in different areas of Ethiopia.

Area	Method	Land preparation		Planting method	% using	Fertilizer use		Weeding method	Harvesting
		Number of plowings	Planting time			Average rate (kg/ha) ^a			
Holeta	Oxen	2-4	June	Flat	30	40	HW/herbicide	Nov.-Dec.	
Inewan	Oxen/ Horses	2-3	Jul./Aug.	BBF	100	50-75	Hand weeding	Dec.-Jan.	
Alelu-Sendafa	Oxen	3-4	Jul./Aug.	Ridges/ Furrows	75	50-75	No weeding	Dec.-Jan.	
Kulumsa	Oxen	3-5	June	Flat	100	90	HW/herbicide	Nov.-Feb.	
Sinana	Oxen	3-4	Mar.-Apr./ July	Flat	10	-b	No weeding	Aug./Jan.	

Source: Various diagnostic survey reports.

^a Most of the fertilizer used is diammonium phosphate (DAP). A few farmers also use urea. Average rate is the rate used by users.

^b Information not available.

Table 8. Percentage of total wheat area planted to semidwarf varieties in selected countries of Eastern and Southern Africa, mid-1980's.

	Area in country planted to semidwarfs (%)
ETHIOPIA	10
KENYA	83
SUDAN	100
TANZANIA	100
ZIMBABWE	100

Source: (5).