Growth from Agriculture in Ethiopia: Identifying Key Constraints

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Agriculture and Growth in Ethiopia[1]

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Summary

This paper assesses the key constraints to stimulate growth and further commercialization of Ethiopian agriculture, with an emphasis on cereal production and based on a critical assessment of the available evidence. With costly connections to international markets due to Ethiopia's geography, cereals are largely non-tradable commodities. Stimulating cereal production remains therefore a priority for an overall economic growth strategy for the near future. It is then imperative to maintain a delicate balance between sufficiently low food prices for long-run economic growth and sufficiently high prices to provide incentive for an agricultural transformation.

Can sufficiently high yield growth be obtained in smallholder agriculture? Currently available improved and hybrid seed technologies are offering some scope for growth but not on the scale often suggested, and only for maize and wheat. Seed multiplication is dramatically failing, and on-farm multiplication schemes are unlikely to reach the scale required. The consequence is that currently supplied packages are imbalanced, effectively combining fertilizer and improved practices without improved seeds. A further expansion of fertilizer-based yield growth is unlikely to be profitable for many farmers. Water remains a key constraint for yield growth, and only in specific locations is irrigation likely to be profitable, and unlikely so for cereals. Extension programmes have expanded but the evidence base on its possible success is entirely missing to allow a serious assessment.

Four key priorities follow from this analysis for smallholder agriculture: first, the need to engage in strategic partnerships for the rapid development of locally adapted improved and hybrid seed technologies; secondly, substantial efforts to stimulate seed multiplication by commercial farmers; thirdly, a rebalancing of efforts away from fertilizer as the key source of yield growth towards effective integrated packages, and finally, careful assessments of current extension efforts and models.

At the same time, a number of neglected areas have been identified. The current model focuses mainly on the production side of smallholder agriculture, relatively neglecting value creation along the supply chain. First, despite reasonably integrated output markets, transactions costs between rural areas and wholesale markets, as well as to international markets remain high despite much investment in road infrastructure. More effort to reduce transactions costs in marketing and transport are required. Secondly, larger and commercial farm investments are treated as a niche sector, removed from smallholder agriculture, while they could be a source of important positive externalities on smallholder agriculture, such as for technology transfer and scale economies in marketing. Thirdly, factor markets for inputs, such as credit and fertilizer, are in principle open to competition but have been characterized by specific measures and interventions geared towards ensuring their operation, at the cost of developing market institutions that are sustainable in the long-run. A reassessment of the benefits offered to current incumbents is required as part of the development of an active competition policy along the agricultural value chain. For input credit, the use of regional budgets as collateral has become unsustainable and new entry by other banking institutions will need to be fostered, which is likely to require new models of insurance to limit exposure of these institutions. Finally, growth and transformation in the agricultural sector will require a sustained growth in demand for its produce. A balance in the economic strategy is then essential to ensure further growth in urban incomes, necessary for agricultural growth.

This assessment of the progress in Ethiopian agriculture and the constraints on its further growth and commercialization has been hindered by the data, and the puzzles and possible contradictions they present. The scale of output expansion in Ethiopia in the last 10 years is unprecedented. According to the data, it involved dramatic increases in areas cultivated with cereals, up 44 percent in the last 10 years, without any clear record or reporting on the process by which more land was obtained. Yields increased by 40 percent in the same period, with most of this growth in the last 5 years, but without any sign of intensification via fertilizer, improved seeds or irrigation, and limited increases in land under the extension programme. As yield growth has fast outpaced the experience elsewhere in Africa or during the Green Revolution in Asia but without input intensification, the sources of yield growth should be understood to restore trust in the current data. In general, more effort should be expended to ensure the auditing of these key data sources on the Ethiopian economy.

1. Introduction

Ethiopia is still a predominantly agricultural economy. Agricultural GDP is about half of total GDP, exports are dominated by agricultural products and more than 80% of the population depends on various forms agricultural production for their livelihoods. The country covers a vast territory but is landlocked, and it is mainly dependent on its links with Djibouti for its imports and exports, putting a limit on the extent it can engage with the international economy as freight costs are substantial. It is also still one of the poorer countries in the world, affecting the economic size of its domestic market in value terms.

Such characteristics lead many to conclude that growth in Ethiopia will have to start from the agricultural sector, as it is where most activity is taking place at present and as it employs most of the labour force. Such a view was embodied in the Agricultural Development-led Industrialization (ADLI) policy framework which argued for a phased development, such as first focusing on output growth in agriculture, through technologies such as fertilizer, seeds and infrastructure, leading to industrialization as agricultural growth will then offer labour. In practice, ADLI implied a focus on increasing land productivity in cereal production via modern inputs (mainly fertiliser) and extension.

In a companion piece to this paper, Dercon and Zeitlin (2009), question this framework from a conceptual point of view, informed by the evidence for Ethiopia. Thinking about growth requires looking for those feasible combinations of available production factors such as land, capital, labour, and technology that would offer the best opportunities for growth in wealth, both by individuals and by the country as a whole. Their core argument is that the best trajectory will depend on (a) the available options, for example in terms of technology and innovation, (b) the nature, functioning and institutional setup of the product and factor markets and (c) the constraints or options available via international trade. The specific nature of a largely agricultural and landlocked 'dual' economy, with a small non-agricultural sector, an agricultural sector dominated by traditional practices, and at present, relatively low levels (even if gradually increasing) urban demand imply a number of key constraining factors for agricultural growth. These constraints imply a more nuanced view of the role of agricultural development is needed, a view that looks at the role of agriculture in the context of the rest of the economy. They argue that ADLI's focus on fostering output growth in cereals was not necessarily wrong, but it implied a relative neglect of other necessary conditions to allow this to start a transformation of the economy. One way of looking at it is to suggest that the implementation of ADLI may have focused too much on output rather than value, and looked at agriculture in isolation of the rest of the economy.

In particular, Dercon and Zeitlin (2009) introduced the delicate balance required of food prices in a closed economy: food prices need to be high enough to ensure incentives for transformation of agriculture via input adoption, but not so high that they limit long-run growth. More specifically, the transformation of agriculture via input adoption will only come about if the *economic* incentives for this transformation are high for farmers. These incentives are strongly affected by prices, suggesting there is an important role to be played by policies that grow urban incomes, which will play an increasingly important role as a source of demand for agricultural goods. At the same time, sustained growth will require that economic transformation begins to take place, with more of the labour force gainfully involved in the non-agricultural sector. To ensure this does not occur at the cost of declining food production, and urban food prices that rise too high—such that any growth induced from increased incentives to input adoption is ultimately retarded by subsequent pressure on urban wages—a continued focus on increasing output is required.

Increasing land productivity continues to play a key role in this. Available technologies are an important consideration. Beyond technology constraints a key issue is whether farms are becoming too small to deliver these productivity increases and whether gains can be had from scale economies in smallholder agriculture. At the same time, an assessment of the scope for larger scale commercial farming, beyond its current emphasis on niche markets for exports, is needed. This can involve a focus on direct output gains in terms of basic staples as well as its potential influence in fostering adoption of high value crops in smallholder agriculture.

Achieving the food price balance also most likely requires an emphasis on productivity increases higher up the value chain, in marketing and transporting produce, well beyond attempts to increase output levels on the farm. Such improvements would ensure that farmers receive higher prices (ensuring output increases offer substantial gains to farmers) while allowing downward pressure on the urban food costs.

Improving marketing and transportation efficiency would also encourage greater integration of Ethiopia's economy into the global economy. Encouraging greater integration could do one of two things. In a time of relatively high global food prices it could provide incentives for technological adoption through opening up an export market for cereal crops. In a time of relatively low global prices it could increase competition through the importation of cheap cereals. In that case, Ethiopian farmers can maintain their incomes even while increased competition from imports is allowed, if they focus on productivity gains higher up the (cereal) value chain and possibly while also shifting into the production of export-oriented and higher value crops. A key advantage of such gradual switch would be to increase labour productivity in agriculture as well, offering higher earnings and therefore poverty reduction in the rural economy as well.

This more nuanced view of the role and nature of agricultural growth was reflected in the Plan for Accelerated and Sustained Development to End Poverty (PASDEP), Ethiopia's guiding strategic framework for the five-year period 2005/06-2009/10. Whilst still recognizing the need for cereal output growth, PASDEP explicitly noted the need to foster linkages across the economy in order to improve the effectiveness of ADLI and argued for increasing diversification into high value products and better integrating farmers with markets. The analysis in Dercon and Zeitlin (2009) suggests some prioritisation among the PASDEP focal areas, namely prioritisation of measures that encourage technology adoption, urban income growth and reduced transaction costs in agricultural markets.

In this paper, we aim to summarize available evidence on the opportunities or constraints for growth in agriculture, relevant for this framework. The evidence is structured along three broad dimensions. First, we investigate the case for rapid growth in yields via two routes: agricultural technology and scale economies. Secondly, we discuss the constraints and opportunities offered by international trade. Thirdly, we focus on crucial parts of the value chain, by discussing whether and how different factors appear to be constraining value creation (including the markets for modern inputs, land, credit and risk, as well as the functioning of the product market).

Before continuing it is perhaps also useful to note what this paper does not do. Whilst recognizing the need for diversification of agricultural production, the paper does not address the question of what crops should be selected for diversification activities in different parts of the country. Rather, the focus of this paper is on how to develop an environment that enables such diversification to take place. However encouraging diversification may in some cases require selection of specific crops and commensurate promotional activities. In such cases specific studies that address the question of crop choice would be required. Secondly, the discussions that follow focus on crop-based agricultural production. Finally, the paper does not address the role of agriculture in predominantly pastoralist hot semi-arid lowlands.[2] These remain important questions to be addressed elsewhere.

Finally, before turning to the constraints, in the next section a brief discussion is in order on the current performance in agriculture, especially in cereal crop production.

2. The Performance of the Ethiopian Agriculture[3]

As discussed at length in Seyoum Taffesse (2008) and Adenew (2009), the current production performance is somewhat puzzling. Agricultural GDP growth has been considerable in recent years, at levels close to double figures, a pattern that appears to be confirmed by looking at cereal production growth. Based on the data from the Central Statistical Authority Cereal production in the period 2004/05 to 2007/08 increased by more than 12 percent *per year*, with a close to 5 percent growth rate per year in area cultivated and more than 6 percent growth in yields (Table 1). The largest expansions in all dimensions were in teff, maize and sorghum. This most recent period is recording by far the fastest growth in cereal output in recent times.

[2] See Hoddinott (2008) for some discussion on this point.
[3] This section draws heavily on Adenew (2009), Eberhardt (2009) and especially Seyoum Taffesse (2008).

Table 1: Cereal Production by crop – 2004/05-2007/08 (1997-2000 E.C.)

Crop	Average - 2004/2005 - 2007/08						
	Number of holders	Production (quintals)		Area Cultivated (hectares)		Yield (quintals per hectare)	
		Level	Annual growth rate (%)	Level	Annual growth rate (%)	Level	Annual growth rate (%)
Cereals	11,156,837	120,629,724	12.2	8,230,211	4.8	14.0	6.2
Teff	5,462,782	24,079,480	15.9	2,337,850	6.7	10.2	7.7
Barley	3,842,462	13,264,217	0.7	1,024,390	-3.4	13.0	4.5
Wheat	4,118,164	22,933,077	2.1	1,439,098	0.6	15.9	1.5
Maize	7,287,931	33,142,865	18.9	1,595,238	9.0	20.6	7.8
Sorghum	4,253,534	22,161,808	18.3	1,429,886	7.4	15.4	8.9

Source: Seyoum Taffesse (2009) based on computations using CSA data (CSA (July 2006), CSA (July 2007), and CSA (June 2008)). *Note*: Cereal yield is calculated as acreage-share weighted average of the yields of the five major cereals listed in the table – they account for more than 95 percent of cereal acreage and cereal output.

Table 2 gives data on a longer period, since 1996/97, adding also the most recent FAO estimates of the 2008/09 harvest, focusing on the five major cereals on private peasant holdings during the Meher season. The dramatic scale of the production expansion is clear, with doubling of production in this period. Also, land under cultivation is now 44 percent higher than in 1996/97, posing questions on where this land has come from and its quality, as land pressure has long been pointed to as a key constraint. Careful disaggregated geographic analysis in Adenew (2009) or Seyoum Taffesse (2008) does not offer a clear explanation. Seyoum Taffesse (2008) reports that the expansion since 1996/97 has been remarkably well spread across all four main regions, with the highest increase in Tigray (71%) and the lowest still 58% in Amhara. Questions also emerge when contrasting this evidence with the rest of Africa and South Asia. World Development Indicators show that cultivated area as a percentage of total land area in Ethiopia has long been above averages for Sub-Saharan Africa, by a factor between 2 and 3. The CSA data suggest that cereal production area as a percent of surface areas is now about 9.3%, compared to an average of about 3.7% in Africa and 27% in South Asia. Calculations by Alemayehu (2008) suggest that the increases in the last decade since 1996/97 put the Amhara region close to South Asian levels, with more than 25% of the surface area under grain cultivation, with Tigray and SNNP not far behind with 18% and 15% of surface area. Given the fundamental differences in terrain and agro-ecological conditions, this is surprising.

Table 2: Area, Production and Yield of Major Cereals (Private Peasant Holdings for Meher Season) 1996/97-2008/09

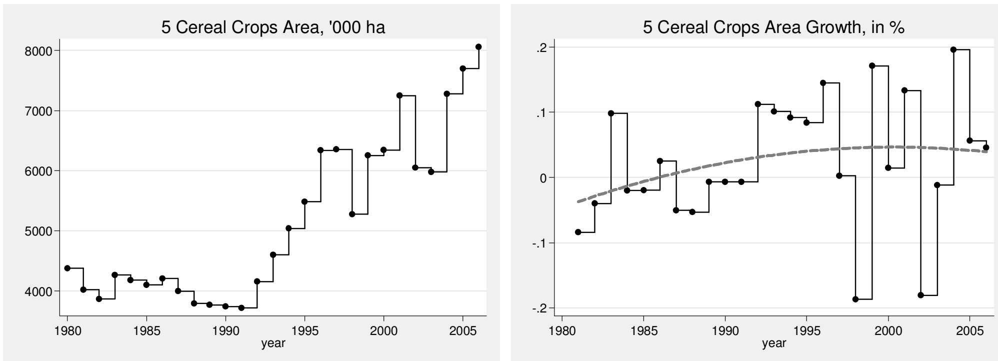
Year / Period	Crop	Production: Level (quintals)	Production: Growth rate (%)	Area Cultivated: Level (hectares)	Area Cultivated: Growth rate (%)	Yield: Level (quintals per hectare)	Yield: Growth rate (%)
1996-1997	Barley	11,934,200		857,450		13.9	
	Maize	19,098,430		1,156,670		16.5	
	Sorghum	14,680,910		988,290		14.9	
	Teff	17,814,880		2,099,780		8.5	
	Wheat	10,626,390		814,600		13.0	
	Main Cereals	**74,154,810**		**5,916,790**		12.5	
2007/08 (growth since 1996/97)	Barley	13,548,071	13.5	984,943	14.9	13.8	-1.2
	Maize	37,497,491	96.3	1,767,389	52.8	21.2	28.5
	Sorghum	26,591,292	81.1	1,533,537	55.2	17.3	16.7
	Teff	29,929,235	68.0	2,565,155	22.2	11.7	37.5
	Wheat	23,144,885	117.8	1,424,719	74.9	16.2	24.5
	Main Cereals	**130,710,974**	**76.3**	**8,275,743**	**39.9**	15.8	**26.0**
2008/09 (growth since 1996/97)	Barley	14,838,000	24.3	951,000	10.9	15.6	12.2
	Maize	48,298,000	152.9	1,977,600	71.0	24.4	48.0
	Sorghum	26,194,000	78.4	1,552,800	57.1	16.9	13.2
	Teff	28,446,000	59.7	2,547,600	21.3	11.2	31.4
	Wheat	31,489,000	196.3	1,506,600	84.9	20.9	60.8
	Main Cereals	**149,265,000**	**101.3**	**8,535,600**	**44.3**	17.5	**39.5**

Source: Seyoum Taffesse (2008)'s computation using CSA data (CSA (March 1999), CSA (2003a), CSA (July 2007), and CSA (June 2008), updated using FAO Crop and Food Security Assessment Mission (2009). Data for 2008/09 are provisional. *Growth rates are total percentage growth in this period.*

Going even further back in time, and comparing area and production data from 2008/9 with CSA area and production data from 1980/1 (although some caution may have to be taken with data from this period) suggests that land area cultivated under cereal production in Meher has roughly doubled during this period, again pointing to a massive expansion (Figure 1). However, as the available estimates for this period suggest that the rural population has roughly doubled as well it implies that the cultivated area per person in the rural sector has actually remained relatively stable, at around 0.12 ha per person! Further inspection of these historical data in Eberhardt (2008) suggests that area cultivated with cereals per person has actually fluctuated around this level both in the early 1980s as in the period since the early 1990s.[4]

[4] This suggests that it may be worthwhile to explore how population figures are used to extrapolated measured areas under cultivation to the entire rural sector, and whether these procedures could have caused some overestimation.

Figure 1: Cropped area trends for the five major cereals (teff, wheat, maize, barley and sorghum), 1980/1-2005/6



In sum, the data on area cultivated with cereals show massive increases over time, but at the same time present many puzzles, including how this fits with the perception of increased land pressure, the quality of the land brought into cultivation, and the sustainability of this process.

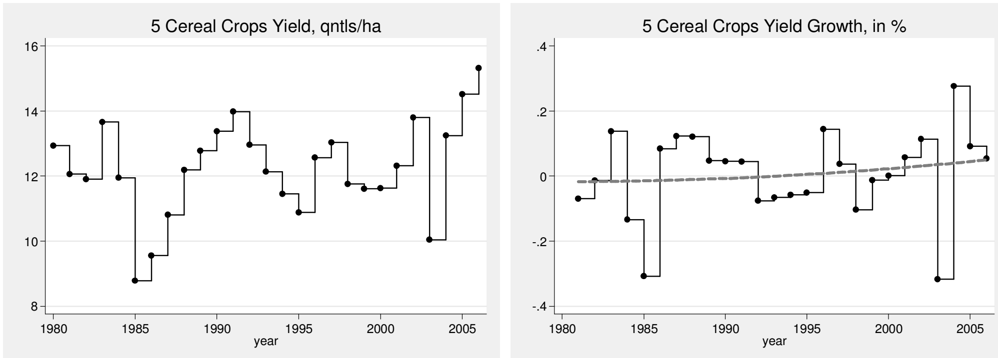
The current high yield growth should also be put into context. Using panel data from the Ethiopian Rural Household Survey, Bachewe et al (2008) show that although there is some evidence that farmers have moved closer to the production possibility frontier (largely on account of increased use of 'traditional' inputs such as land, labour, oxen and hoes), there is no evidence that the production possibility frontier moved out in the period 1994-2004, indicating little technological change or intensification. This would be consistent with the CSA figures for the same period.

Figure 2 shows that in the very last few years yields are systematically higher than long-term levels, based on a compilation of data from CSA for all available years (private peasants, Meher season) of average cereal yields. From 2004/05 onwards yields rose above the higher levels attained in the 1980s or 1990s. Whether these changes from long-term patterns are truly structural breaks or affected by measurement problems remains disputed. Using a nationally representative, but small, household survey Minot (2008) presents evidence that would be consistent with some over-estimation of yields in CSA estimations in recent years. The latest estimates based on satellite data using crop-moisture models from FAST also suggest that yields for maize and wheat this year are similar to compared to the average of the last five year average (2003/04 to 2007/08) rather than the vast increases observed in the CSA data, while this year was about 8% worse than last year according to their estimates for both crops (EARS TAST (2008)). The CSA data can then not be accounted for by agro-climate conditions, making work on the implied sources of productivity growth even more important.

Questioning the CSA yield data is not self-evident. In principle, the methods used, based crop-cutting using a statistical sampling design, should offer superior data to other sources, and alternative methods can be questioned. In principle, if yield increases stem from systematic productivity increases, then extrapolations from climatic data are not necessarily going to show these. Household cross-section survey data based on self-reported output and yield are similarly not necessarily showing lower measurement error, and are definitely not likely to pick up upward or downward trends.

Whilst not conclusive, it raises the importance of further research on this issue. Two additional points also point to the need for further investigations in this area.

Figure 2: Yield trends for the five major cereals (teff, wheat, maize, barley and sorghum), 1980/1-2005/6



Source: Eberhardt (2009), based on CSA publications. Note that the data for 1988/89-93/94 and 1986/87 are interpolated on the graphs.

First, the recent large increases in reported yields are not explained by a sudden large increase in uses of modern inputs. Table 3 gives an overview, based on data from the Central Statistical Authority. Fertiliser use was by 2007/08 not clearly superior to before, in terms of area covered or application rates. Improved seed use is still below 5 percent. Pesticide use is higher. Irrigated area increased since 1997/98 but did not grow between 2001/02 and 2007/08, and is still only about 1 percent. The expansion of the extension package is clear but still covering less than 15%. In short, at least in terms of these descriptive statistics, yield increases at the rate observed (up more than 40% since 1997/98) are not easily squared with the absence of rapid, large scale intensification via modern inputs.

Table 3: Modern Input Use 1997/98-2007/08 on Cereals

	2007/08	2001/02	1997/98
Fertiliser Applied area (share in total area cultivated - %)	39.0	42.8	32.3
Fertiliser application (total quintals/ total hectares)	0.45	0.30	0.37
Fertiliser application (quintals per hectare of fertiliser applied area)	1.16	1.00	1.15
Improved seed applied crop area (% of crop area)	4.7	3.5	2.4
Pesticide applied crop area (% of crop area)	20.8	10.8	12.0
Irrigated crop area (% of crop area)	1.1	1.3	0.6
Extension package covered crop area (% of crop area)	14.5		

Source: Calculations from Seyoum Taffesse (2008) using CSA data (CSA (September 1998), CSA (July 2003b), and CSA (August 2008)) for all cereals.

The fact that fertilizer use has not increased substantially may be considered puzzling in view of the large increases in fertilizer imports in the recent decade. Figure 3 offers data from MoARD on total sales of fertilizer in this period, based on supply data (and not from household data as above).

Figure 3: Fertilizer sales 1996-2007

Looking at sales, there clearly has been a fast increase (figure 3): fertilizer sales grew by 75% in the decade from 1997 (compared to 1994, sales have even doubled). However, since 1997, area cultivated with the main cereals expanded by about 56%. The result is that the impact on yields will have been dissipated across a larger area. This is well illustrated by figure 4, which gives total fertilizer use in kg per total area cultivated by cereals[5], offering a sense of how fertilizer intensity has increased. Three series are offered: the FAO and MoARD are two series of sales of fertilizer (which are virtually identical but of different length, with former based on MoARD sources), while the third series is the consumption series based on aggregating the household level reported data from the CSA. The latter series deviates considerably in 2001 until 2004, but is fully consistent in the earlier part and the later part of the period considered. Strikingly, even though intensity of use in kg per ha has increased compared to 1997, the levels in the period since 2004 have only increased marginally, and are now close to levels obtained in 1998 and 1999. This means that, *given the large increases in overall land area cultivated with cereals*, fertilizer sales have only just kept up with levels of the late 1990s. Average reported cereal yields were nevertheless only about 12 quintals per ha for the main cereals in that period, climbing to 15 quintals after 2004 and even 17.5 quintals by 2008/09. The available data on fertilizer and its usage can there not quite account for the increase in yields, despite the large increases in fertilizer available and sold in recent years.[6] The fast increase in land under cultivation has largely dampened any increase in the average amount of fertilizer used per hectare of land under cereal cultivation.

[5] Fertilizer sales data do not distinguish sales for non-cereals and cereals, and some non-trivial amounts are used for other crops, but the data are given an indication of overall fertilizer intensity.

[6] Looking further at the data, it is clear that the application rate of fertilizer (fertilizer per ha of land that uses fertilizer) has not increased in this period, so that the entire increase in total fertilizer use has resulted in more hectares of land that are using fertilizer. Table 3 illustrates this: the application rate is now roughly the same as in 1997 at just under 1.2 qt per hectare of fertilized land.

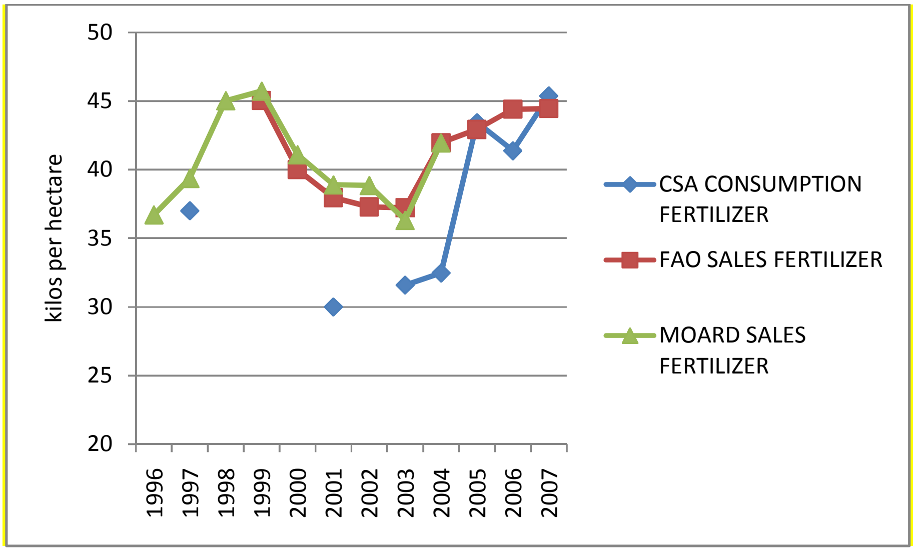


Figure 4: Fertilizer intensity: fertilizer sales per cultivated area

Second, yield growth in Ethiopia has been comparatively high when considered in the context of recent experience in some key crops across the world. Maize and wheat are two crops which have been relevant in the green revolution in Asia and are also grown in neighbouring African countries; they are also two crops of focus in the efforts to increase yields in Ethiopia via improved seeds and technology.

Table 4 brings together some data on the percentage gap in yields between Ethiopia and these other countries. Each number gives the percentage by which yields in Ethiopia are higher than in the relevant country. In the last four years, Ethiopia has strongly surpassed the East-African countries shown below, including Kenya and Uganda that used to have considerably higher yields in wheat and maize in the 1990s and the beginning of the century. This includes wheat, which has been successfully grown commercially in Kenya for decades. Even more remarkably, it has rapidly narrowed the gap with India in wheat, a key green revolution crop, to about 20%, from 50% in the decade 1993 to 2003. The type of increase in wheat yields, attained between 2003 and 2007 in Ethiopia (from about 14 quintals to 21 quintals) took India from about 1975 until 1990, and took China a decade to complete from the early 1970s.[7] This would suggest one of the fastest 'green revolutions' recorded in history. Even though the types of cereals are not the same, neither Vietnam, China or India have ever seen in growth in average yields of a similar scale[8], but contrary to these countries, this growth cannot be easily attributed to rapid change in technology or input use.

[7] It could be argued that looking at growth between 2003 and 2007 in isolation is misleading as weather conditions improved after 2003 rather considerably compared to the period 1999-03 period, and wheat yields were in most of this period also not far off 14 quintals. This does not explain the large increase post-2003, and especially after 2005, as figure 5 showed that this is not a period of further intensification, while weather conditions were not particularly better in 2007 or 2008, than in 2005.

[8] For example, comparing the average of the last three years to the average in the preceding four years, yields of all cereals grew by 40 percent in Ethiopia; no similar periods of fast growth can be found in the FAO data on the three named countries.

Table 4: Percentage Yield Gap of Ethiopia compared to selected countries in selected years

	Maize			Wheat			Cereals (FAO definition)		
	1993/2003	2005-07	2008	1993/2003	2005-07	2008	1993/2003	2005-07	2008
Kenya	0%	30%	34%	-32%	-15%	-2%	-25%	-10%	10%
Malawi	20%	59%	64%	89%	28%	47%	-1%	29%	34%
Tanzania	46%	108%	115%	-3%	47%	68%	15%	58%	63%
Uganda	1%	54%	59%	-27%	6%	21%	-15%	20%	24%
India	-8%	16%	20%	-50%	-30%	-20%	-48%	-37%	-23%
China	-67%	-57%	-55%	-65%	-59%	-53%	-65%	-59%	-53%
Vietnam	-37%	-37%	-35%				-67%	-61%	-60%
USA	-80%	-75%	-74%	-51%	-32%	-21%	-76%	-72%	-71%
LDC	35%	66%	71%	-9%	3%	18%	-11%	5%	8%
Landlocked LDC	-1%	32%	36%	4%	10%	26%	12%	30%	34%

Source: FAOSTAT data up to 2007. Data for 2008 are from FAO (2009) for Ethiopia compared to 2005-07 for other countries. LDC and Landlocked LDC are less developed countries and the least developed countries that are landlocked (all based on FAO definitions).

Overall, the data for Ethiopia suggest vast production increases based on apparent massive increases in land brought under cereal cultivation, and large recent increases in yields, and both these mechanisms are not easily explained. The massive price increases in food prices in the last two years are also not easily squared with bumper harvests.[9] These puzzles do ask for the generation of more systematic evidence to either confirm or contradict these findings on recent patterns. Our discussion below is not dependent on whether any of these data should be disputed. Our concern is with the constraints and opportunities for further growth and how agricultural growth can feed into broader economic transformation.

An immediate concern is nevertheless for further inspection of the current database and the recent yield trends. Given that a crop-cutting method has been used, CSA data should in principle be superior. But in practice, they leave many questions unanswered. Even if we dismiss the alternative sources and the international evidence, the official yield data are not easily squared with the data on input use. A systematic review of how the CSA data are collected and collated as well as studies that aim to explain the yield increases are urgently needed.[10]

[9] Bumper harvests could be squared with upward pressure on prices but requires very strong assumptions. Bumper harvests are unlikely to reduce the amount of food sold by farmers, unless they have income elasticities above one, which is unlikely as food has the characteristic of a luxury, They may nevertheless sell more inferior staples (such as sorghum) and sell less cereals like teff, so the marketed surplus of teff may go down, even if the overall marketed surplus of food increases. When food prices go up due to external circumstances, the overall marketed surplus may however go down. From the standard agricultural household model (e.g. Singh et al. (1986), it can be shown that upward pressure on prices (for example when international prices are rising or imports are constrained) may induce farmers to increase their own food consumption and sell a lower share of their harvest on the market if the income elasticity of food is high for them and if they are surplus farmers to start with. Even if not as high as one, the evidence suggests that income elasticities for food may well be high and much additional income is spent on food in rural Ethiopia. At least theoretically, the impact of rising prices may then undo the impact of a bumper harvest, but this would require rather unlikely high income elasticities.

[10] One possible explanation cannot be dismissed. If the land area under cereal cultivation were overestimated, then the input use data may well be more consistent with intensification, as the denominator in national application rates per hectare would become smaller than implied by the figures, such as in table 3. As yield

3. The Scope for Further Yield Growth

3.1. Technology

The data above suggest that despite apparent yield improvement, the evidence on increased *adoption* of new technology is not overwhelming. In this section, we discuss the scope for technology adoption in Ethiopia. There are several preconditions for adoption of agricultural technologies, as set out in Dercon and Zeitlin (2009). In particular, one requires a really good – and locally adapted – innovation such as IR8 in India, or CIMMYT's wheat in Mexico. The key to these innovations was that they offered massive yield gains (in the order of five times higher yield on trial plots than traditional seeds). At the same time, the economic returns to adoption have to be high. This implies that high output prices are often needed as changes in production practices are often required for the full potential of new seeds to be realised. In the case of the green revolution in South and South East Asia, improved seed varieties yielded especially high returns when non-organic fertilizer was applied or when they were planted in irrigated lands (Otuska 2008). These further required changes cause the economic returns to improved varieties to be lower than what they may seem at first from small scale trials. Additionally the strategic interest in waiting to adopt that is present at early stages of the diffusion of innovations, necessitates the presence of high returns to compensate for this.

Evidence to date

Comparatively, yields in Ethiopia, until a few years ago, were still low, and as argued above, the trends in cereal production over the past quarter century point to little sustained growth in yields. Cereal yields have fluctuated between 10 and 14 quintals per hectare. Recent data suggest a dramatic change in fortunes, with evidence of a trend growth of about 5%, in yield. Even so, analysis of cereal production figures for the decade 1996/7 to 2007/8 suggests that growth of wheat, maize, barley and sorghum has been driven more by area expansion than increases in yield (Seyoum Taffesse 2008).

The data above also show that little of the growth in yields reflects changes in the use of inputs. Whilst more fertilizer and improved seed is purchased and used in production, this increase has not outpaced growth in the area of land cultivated. There has been growth in the area of land planted with improved seeds, but it remains very low at under 5%. Irrigated area also remains very low at 1%. Only pesticides show a substantial increase in recent years, but this is unlikely to have been able to deliver large yield increases across the board. More land is brought under the extension package as well, but still, at below 15%, this is unlikely to be responsible for the massive yield increases. Similarly, other efforts have been made to reach farmers with more information and learning, but again, whether this can have been responsible for the massive turnaround in agriculture is unclear.

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figures are independently collected, they would not require revising in that case. It would nevertheless imply that national cereal production would be overestimated by the factor by which area cultivated is overestimated, with likely implications even for GDP and GDP growth estimates.

The data presented capture national trends and masks substantial heterogeneity in the use of inputs and level of yields across the country. Some zones apply almost no fertilizer, whilst others—Hadiya (in SNNPR), West Shoa, East Shoa and Arsi (in Oromia) and East Gojam and West Gojam (in Amhara)—apply fertilizer to 61% of cultivated area and experienced yields of about 1 quintal per hectare higher than the national average (Adenew 2009, using 2004 data). Use of improved seeds was also about 1 percentage point higher than the national average in these zones.[11] This heterogeneity is nevertheless not of a scale to help to understand the large yield increases recently observed. Seyoum Taffesse (2008) reports on a systematic attempt to see whether the distribution of yield increases across zones can at all be linked to zonal characteristics that could be expected to positively correlate with them, such as agricultural potential and connectivity to urban areas. The findings were that they were not at all following such a pattern. There was no systematic relationship between yield gains and areas that have particular high potential for cereals such as wheat or maize. There was similarly no impact from connectivity, with remote and non-remote areas offering no explanatory power for explaining geographical differences in yield gains.

Are improved technologies really available?

A careful review of the available evidence suggests that many of the needed technological advances in Ethiopia's predominant crops (wheat, maize and teff) have not been delivered by the international research system (Otsuka and Kijima 2008). Although improved seed technologies do exist for Ethiopia, the yield increases they offer are not on the same scale as the technological developments that sparked the green revolution in India. The IR-8 in India offered five-fold yield increases in plots where no fertilizer was used, and even more substantial yields on plots with optimal growing conditions.

In Ethiopia hybrid maize seeds offer the largest yield gains. When combined with increased fertilizer use and improved production practices hybrid maize seeds have substantially higher yields. This was demonstrated by the Sasakawa Global 2000 programme from 1995-99, and this programme is regularly quoted as evidence for the potential of this technology. The comparison of yields under this package to the national average is indeed quite dramatic (Table 5), with yields under Sasakawa Global 2000 almost three times as high. However, this evidence has often been misinterpreted. In practice, these yield differences are as a result of a number of factors including the selection of high agricultural potential sites for inclusion in the programme, and not a directly replicable yield difference if it were to be applied by typical maize producers. The evaluation of the Sasakawa Global 2000 package (Howard et al 1998) highlighted that those farmers that who participated in the programme had larger land, more manpower, greater livestock wealth and higher levels of literacy than the average farmer in their woreda. Two of the study sites were located in woredas (East and West Shoa) that were better off than the national average on these characteristics.

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[11] Sufficient research is not available to determine what the underlying causes of such clustered adoption are. It could arise as a result of clustering in demand for inputs, perhaps driven by differences in agronomic conditions that affect the returns to inputs, differences in income levels that determine individual's purchasing power, or as a result of the presence of S-shaped adoption curves as discussed in Dercon and Zeitlin (2009). The observed clustering could also be driven by geographical variation in the effectiveness of input distribution systems, i.e. clustering the supply of inputs.

Table 5: Yields in on-farm field trials vs. farmers' yields, 2000-2004 (metric tons/hectare)

Crop	NAEIP (1995-1999)		Sasakawa Global 2000 (1993-1999)		Recent farm yields (2000-04)
	Improved	Traditional	Improved	Traditional	
Maize	4.73	1.57	4.60	1.57	1.82
Wheat	2.93	1.17	2.31	0.95	1.31
Sorghum	2.79	1.12	2.08	0.92	1.21
Teff	1.43	0.85	1.62	0.64	0.82
Barley	2.15	1.00			1.05

Source: Spielman 2008 using data presented in World Bank, 2006a. [a] NAEIP is the National Agricultural Extension Intervention Program.

The evaluation compared programme and non-programme participants in selected sites. Three-fold yield increases in maize yields were observed among programme participants in Jimma, and a 50% yield improvement in West Shoa. No difference was found for Teff yields among programme participants. When observable differences between programme and non-programme participants were controlled for the magnitude of the improvement in yields was smaller. For example, in Jimma soil type was a significant determinant of yields with yields in red soil plots 1.5 tonnes higher than yields from gray or black soils. Improved production practices also helped increase yields. The timing of planting, spacing of maize seeds and land preparation were all significant in explaining variation in yields.

There are also some further caveats to the analysis, even when observed characteristics of farmers and plots were controlled for. The number of participants using traditional practices was very small in some locations (only four farmers in Jimma, the site in which the highest yield differences were recorded), and unobservable differences in farmers who adopted the package and those that did not (such as experience in farming) were not controlled for. Overall, the evidence above does not suggest scope for a 'green revolution' for maize and other crops with up to three-fold yield gains on offer from a package of fertilizer and seeds. In fact, proper scientific evaluation studies point to lower gains than those implied by Table 5.

Seed trial studies control for observed and unobserved differences in plot types and farmer characteristics by assessing yield differences across seeds grown in the same plots under the same production practices. The most promising yield gains from improved seeds are generally acknowledged to be available for maize. On-farm seed trial studies undertaken by national research organizations in Ethiopia show that, on average, hybrid or improved maize seeds give a 20% increase in yields when traditional production practices are used, and a 49% increase in yields when improved production practices are used (calculated from summary data presented in Anchala et al 2001, see Appendix). Improved practices include optimal fertilizer use, but also optimal timing and practices for sowing, weeding and harvesting. On-farm seed trial studies also indicate that improved practices (taken to refer to the combination of fertilizer application and adoption of optimal farm management practices in weeding, timing of planting, seed rates etc.) increase yields by 54% for local seeds and 69% for improved seeds (Anchala et al 2001). Combining both improved or hybrid seeds with improved practices compared to traditional seeds with traditional practices offers on average 134% gains – considerable but below the gains presented by the SG 2000 (which suggest

193% gains for maize). Of this 134% increase, 20% comes from seeds alone, 54% from improvements in practices, and 60% from the interaction between the two. The size of the interaction effect indicates that undertaking the full package of improved seeds, fertilizer and improved farm management practices together is crucial. For other crops, appropriate adapted high yielding seeds are barely or not available, limiting the gains as documented in on-farm trial studies to levels well below the 125-150% gains suggested by SG 2000 for wheat, teff and sorghum (table 5). Only for wheat can substantial yield gains be obtained from fertilizer, and not for the other crops. One careful review of on-farm trials for wheat suggests that fields with optimal fertilizer application can produce between 42-109% more than fields without any fertilizer (Teklu et al 2000).

Estimates based on detailed farm or household surveys cover much larger geographical areas than on-farm trial studies (which are often based near research stations), and often aggregate across crops, offering an estimate of the overall impact of fertilizer use or improved seeds. These estimates are typically lower than those obtained from on-farm trial studies. Production function estimates using the CSA 2000/1 sample census data, presented in World Bank (2006), indicate that the returns to using improved seeds are 24% on unfertilized plots. At 21% returns to improved seeds on fertilized plots are similar to those on unfertilized plots—this is perhaps because there are few plots in which both improved seeds and fertilizer were used, but suggests that overall lower gains are obtained in practice compared to trial studies. Similarly, the ERHS data was used to estimate the impact of fertilizer on yields, and found that with median levels of rainfall yields are 24% larger on plots in which a close to optimal amount of fertilizer is applied (Christiaensen and Dercon 2006). This averages the impact across all crops, seeds and practices. In practice, fertilizer application is often less than ideal—a World Bank study found that many farmers (80%) were using more than the efficient amount of fertilizer (World Bank 2006)—perhaps explaining the lower returns found for a random sample of farmers.

Overall, evidence from on-farm trials and production function estimates indicate some agricultural growth potential arising from improved production practices and improved seeds, although not as large as that of the green revolution technologies in India that allowed paddy yields to increase five-fold without changing production practices, and ten-fold when production practices were also changed, or to increase wheat yields up to five-fold. With such dramatic success on the trial fields, it took India since the start of the green revolution period in the mid-1960s about 30 years for wheat yields to treble and 35 years to double paddy yields (data from FAOSTAT). Local adaptation and the required changes in practices take a long time to achieve (see Dercon and Zeitlin 2009 for a further discussion). In short, what is on offer in Ethiopia may take a long time to translate in sustained yield gains at the more typical farm level to levels close to what the trial and other evidence suggest is attainable.

A further factor constraining adoption is that higher yields will not drive farmers to adopt new technologies and practices, unless they translate in actual higher economic returns. Even given the high crop prices observed in Ethiopia it is not clear that they are high enough to reward the yield increases that are currently available with new technologies. In the case of fertilizer, it has long been a source of contention as to whether it is really profitable for most farmers to use, as the additional earnings it may bring is not necessarily outweighing the high prices for fertilizer as well as the risks associated with spending on modern inputs (see below for a further discussion). Demeke et al (1997) show that for any given level of input and output prices, the profitability of fertilizer is likely to be highly variable across different parts of the country. Wheat and teff growing areas in the Arsi and East Shoa zones and some maize and barley growing areas in SNNPR were found to have higher levels of profitability than other parts of the country (results cited in Adenew 2009).

More generally, given the costs of changing production practices associated with potential yield increases, the risks associated with the new technologies, and individuals' strategic interests in waiting, it is not clear that what is on offer can induce most farmers to change from current practices. The development of suitable much higher yielding varieties is essential for technological advances in Ethiopian agriculture and all evidence points to an urgent need for new suitable crop technologies for Ethiopian farmers.

The next sub-section considers what growth could come from wider adoption of new technologies was higher adoption undertaken. It also highlights how this scenario would look quite different were new crop technologies with higher yield increases developed. The final sub-section discusses some steps which would facilitate increased technological innovation for Ethiopian agriculture.

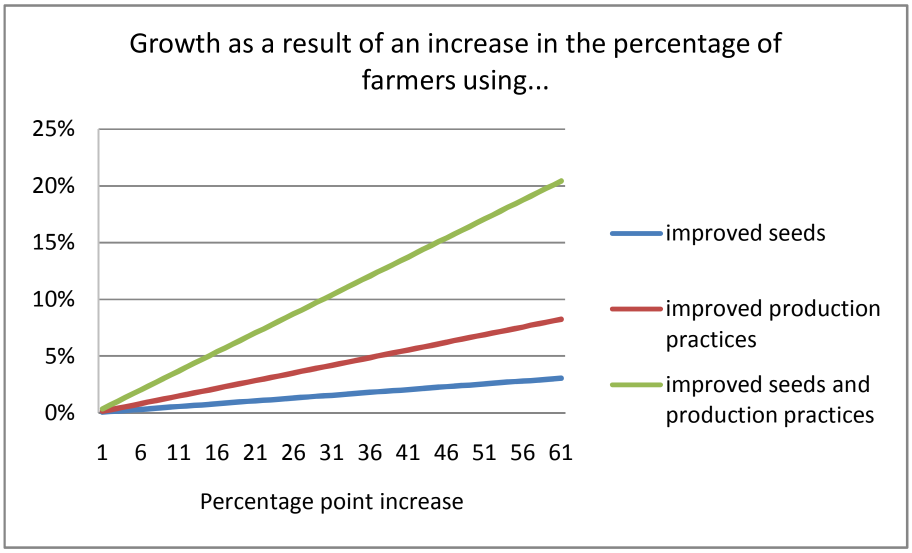
Looking forward

Under current production practices it is estimated that using improved maize seeds increases maize yields per hectare by 20%. Combining improvements in production practices with improved seeds would increase yields by up to 134%. Figure 5 indicates what would happen if (i) the proportion of farmers using improved seeds increased, other things equal, (ii) the proportion of farmers using improved production practices increased, other things equal, and (iii) the proportion of farmers using improved seeds and improved production practices increased. We assume that prices stay constant as output expands, and that the share of land planted to maize per farmer also does not change(estimated at 25%, given about 60% of all farmers grow maize and maize represents 15% of cropped area, Minot 2008). Increasing the proportion of farmers using improved seeds by 10% will result in a one-time increase in output of 1%. Were adoption to increase to all farmers that currently grow maize, agricultural output would increase by only 3%. Improving production practices and using fertilizer by 10% results in growth in agricultural output of 1%, combining improved production practices with seeds brings growth of 3%. Extending improved production practices and improved seeds to all maize growers would bring a one-time growth in agricultural output of 20% through yield increases.

However, this projection assumes that there is no subsequent impact on prices of an increase in maize production, and therefore offer too optimistic an impact on farmers. Given Ethiopia can be considered a closed economy with respect to cereals (Dercon and Zeitlin (2009)), without a commensurate increase in demand for cereals prices are unlikely to remain unresponsive (as was observed during the bumper maize harvest of 2001) causing the agricultural growth that would result from increased adoption to be substantially lower than this. As Section 4 highlights, the 2001 maize harvest was associated with a price fall of 60% to the import parity price. Were a substantial increase in maize output met with a similar price response, then revenue growth may be less than half of output growth.[12]

This projection also assumes that average yield increases observed in field trials are the yield increases available to all maize farmers (on average). Given the agro-ecological variation in Ethiopia it can be expected that available yield increases will vary with location. If field trials were conducted more often in sites with high agro-ecological potential, they may overestimate the average gains to the adoption of new technologies and practices nationally.

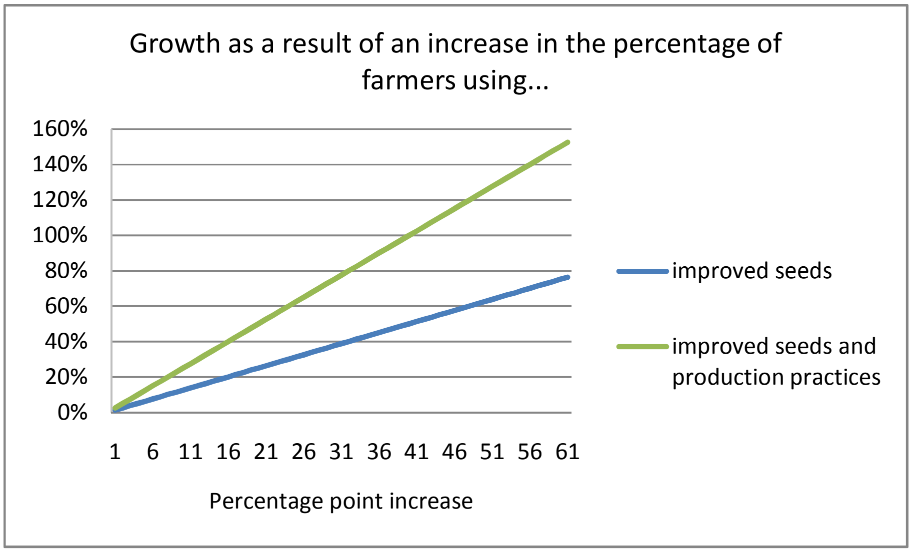
Figure 5: Growth in output from improved maize technology



Making the same strong assumptions, Figure 6 presents the growth that would result were there innovations in maize technology similar to those for rice in the green revolution. Full adoption of improved seeds by maize farmers would result in output growth of almost 80%, even were production practices not improved. When combined with improved production practices, more than 150% growth in output would result. Comparing this 150% growth in output with the 20% growth that can be achieved with current maize technologies, highlights the need for new technological development agricultural growth in Ethiopia. Particularly given maize is currently by far the most promising crop for Ethiopia in terms of the availability of potential yield gains from new seeds and complementary inputs and practices.

[12] However, this process of declining prices may have some further positive impacts as well. In particular, if lower cereal prices facilitate movement of labour into non-agricultural sectors, growth rates may not be so low. Additionally, if increasing adoption of existing improved varieties also increases the ease with which additional new varieties are adopted (as suggested by the experience of Vietnam, see Dercon and Zeitlin 2009), increasing adoption of improved varieties would make subsequent adoption of new technologies more widespread ensuring higher growth rates from new seed technologies. A similar argument could be made if the infrastructure developed to make existing seed technologies more widespread allowed for easier diversification into higher valued agricultural production.

Figure 6: Potential growth in output from green-revolution style new technologies



Considerations in achieving the growth potential

Wider adoption of existing technologies—especially when adoption combines the use of improved seeds, inorganic fertilizer, irrigation and improved farm-management practices—will bring about some agricultural growth in Ethiopia. Facilitating this adoption requires the development of well-functioning input markets and extension. This is considered in Section 5. Here we consider how to encourage the development and adaptation of new technologies for Ethiopia.

It is widely perceived that international firms and organizations (both public and private) are the appropriate place for investments in technological developments that have benefits beyond the border of one country. Closer collaboration with CIMMYT to ensure better adaptation of existing technological advances in maize and wheat, and future developments such as in drought-resistant maize could benefit Ethiopia (it is estimated that drought tolerant varieties of maize would increase yields by 25-30% under moderate drought conditions, Monsanto 2008). However, given the substantial investments needed to deliver the technological advances that Ethiopian agriculture needs, it is quite likely that increased research on the technological barriers faced by Ethiopia needs to be undertaken by centres of technological excellence in the private and public sector exploring a variety of methodological approaches (including genetic modification and nanotechnology). By signalling its commitment to the use of improved seeds that are developed, the Ethiopian government could greatly encourage both private sector financing and philanthropic commitments to this type of research. The development of new technologies is costly with highly uncertain returns; furthermore, patents and property rights may hinder the access to poorer countries such as Ethiopia to its benefits. Financing models, such as described in Masters and Delbecq (2008) could offer mechanisms to overcome these constraints.

Whilst innovation at the international level is important for Ethiopia, a strong agricultural research system is essential to ensure that technologies that are developed can be adapted for use in the Ethiopian context. Most modern varieties are location-specific (Otsuka 2008). The complex and varied agroclimatic conditions found in Sub-Saharan Africa, and the higher incidence of disease found in farming systems under stress, makes this particularly important (Binswanger et al 2008). This has two implications for Ethiopia: (i) first it requires that, as in other countries, there is a strong national research system with the capacity to adapt technologies developed in international research institutes for the specific context of Ethiopia, (ii) secondly, and perhaps more importantly for Ethiopia given the wide heterogeneity in agro-climates found within the country, these technologies need to be adapted separately for many different areas within the country. This does not require decentralization of research capacity, but it does require a strong knowledge of the different soils and climates found within different areas. National agricultural research programs made significant contributions to the adoption and adaptation of high-yielding rice technologies in Vietnam (Otsuka 2008), and Brazil's first-class national research system was similarly essential in achieving soybeans yield increases (Binswanger et al 2008). Although the number of plant breeders in Ethiopia has increased by four-fold in the last twenty years, the Ethiopian Institute for Agricultural Research employs about 300 scientists (Tefera 2006) compared to more than 2000 in Brazil's national agricultural research organization (almost three times the number of scientists per capita). Adaptation of existing seed technologies is thus quite slow in Ethiopia, evidenced in the development of 23 new maize varieties for Ethiopia in the last 31 years (Alemu et al 2006) compared with "dozens" (Tran and Kajisa 2006, p. 171) of rice varieties in Vietnam in the 1990s alone, or the development of some 40 new soybean varieties in Brazil at the start of its soybean expansion (Binswanger et al 2008). Ethiopia needs to invest in the capacity of its national research and extension systems to facilitate technology transfer. International evidence also suggests that the private sector can play an active role in varietal development (Binswanger et al 2008). Currently, Pioneer is the only private firm involved in such adaptation activities in Ethiopia (Tefera 2006). In short, the structure of the adaption process for technological innovations could do with a determined overhaul and expansion, focusing on innovation and local adaption, via stronger interactions with the private sector, both international and domestic, and international research institutions.

3.2 Scale of Production

A second source for growth in yields could be to ensure production is organised at its optimal scale. The optimal scale for agricultural production is affected by the presence of fixed costs in production technology or marketing practices, and the nature of input markets that may cause the cost of factors of production to vary depending on whether they are sourced within or outside the household. The production technologies that underlie unmechanised agricultural production have been found to exhibit constant returns to scale, and any fixed costs present in marketing are often outweighed by the high costs of hiring labour outside the household. The difficulty of perfectly monitoring effort expended on the production of commodities that depend so much on nature, causes family workers to work more efficiently than hired wage workers (more so than in industries where effort is easier to monitor). As a result a body of international empirical evidence has found that family farms that hire little or no external labour can operate more efficiently than large-scale farming that relies on large amounts of hired labour, and decreasing returns to scale are often observed in agricultural production. As Hayami (2005) notes, because of this, family farms remain the dominant form of agricultural production in high-income economies such as Australasia and

North America. Commercial farms in these countries may be large by virtue of mechanized agricultural practices, but the majority of the core farm operations are based on family labour. A number of empirical studies have indeed found an inverse relationship between farm size and yield for unmechanised farming systems such as Ethiopia's, both holding other inputs constant (for example, Binswanger et al 1995) and when not (for example, Barrett 1996). However, other studies (e.g. Benjamin 1995) have shown that it is very difficult to identify the relationship between size and productivity as land of higher quality is usually farmed in smaller-sized plots, whilst land of marginal productivity is farmed more extensively.

However, decreasing returns to scale may not be in place across all farm sizes. Once farms can rely on family labour to meet production needs, there may be no efficiency gains in moving to a smaller farm sizes. Additionally, increasing returns to scale can result from imperfections in land, labour or credit markets combined. One such combination that would explain this relationship is imperfections in both the land and labour markets that simultaneously limit the amount of land that a given household can farm and the degree to which they can buy or sell labour can result in decreasing returns to scale.[13] In particular a situation in which there is surplus labour and inadequate farm sizes. Institutional constraints that prevent the movement of labour from the rural to urban sector, such as preferences for owning a family farm (such as was the case in pre-war Japan, Hayashi and Prescott 2008) can result in a situation of excess labour in the rural sector and smaller than efficient farm sizes. However, as discussed in Dercon and Zeitlin (2009), it is important to note that finding decreasing or increasing returns to scale for a given set of agricultural technologies and practices, does not provide any intuition as to whether larger farms using different practices and technologies would result in higher yields.

Evidence to date

There are increasing concerns that as rural population pressures increases, and as family farms are fragmented further with each generation, the scale of operation of Ethiopian smallholders is becoming too small.There is some evidence of a small decrease in average field size (from 0.22 to 0.18 hectares) from 1997/8 to 2000/1, but data from the Ethiopian Rural Household Survey panel suggests that farm-size per capita has been more or less constant over the last ten years, and, as was suggested in section 2, aggregate evidence on the area of land under cultivation suggests that large rural population growth has been absorbed in rural areas not through dwindling farm sizes but by bringing more land into cultivation. It is unlikely that such area expansion is sustainable in the long run, which means that at some point, if not already, population pressure will put increasing pressure put on the scale at which households farm.

Currently the evidence on the presence of returns to scale in Ethiopia is somewhat mixed. There is some evidence of productivity increasing with scale as the value of production per hectare has been found to be higher on plots with larger areas (controlling for other factors) suggesting increasing field size would increase productivity (World Bank 2006, Bachewe et al 2008), particularly in food

[13] Higher yields on larger farms can also be indicative of missing markets for insurance and credit, as households with smaller farms that are unable to insure themselves through well-functioning credit and insurance markets, are more likely to engage in low variability and low return production. The evidence for the presence of this market failure is considered below.

deficit areas where average land holdings are 0.57 hectares per household, (constant returns are found in food surplus areas where average land holdings are 1.38 hectares per household (World Bank 2006)). Bachewe et al (2008) also find that farm "inefficiency" falls with farm size, and there is also some evidence of surplus labour: increases in family size are not associated with increased agricultural productivity at the margin, which is indeed indicative of the presence of surplus labour in rural areas (World Bank 2006). As part of this study, detailed analyses of plot level data collected as part of the ERHS panel were conducted, using careful statistical techniques to avoid any spurious findings. It was found that yields decrease with plot size, and that the more standard result of decreasing returns to scale holds true (Eberhardt 2009).

Looking forward

To the extent increasing returns to scale are found in agricultural production, expansion in land holdings has an increasing impact on growth. The results of the analysis undertaken for this study indicate that there will be no impact on growth from such a process. However, even basing ourselves on those studies that do find increasing returns to scale, we can show that their evidence suggests that consolidation of land holdings that could occur as a result of migration would increase growth only minimally. Table 6 uses estimates from World Bank (2006) to calculate what the impact of migration-induced consolidation of land holdings on growth might be. In the calculations it is assumed that land that becomes available from migrating households is distributed equally to all households left in rural areas. We assume that there is no increase or decrease in per capita land holdings in the absence of migration. We also assume that there is no change in the value or structure of production in the presence of migration, which is unlikely to be the case. Given these assumptions consolidation resulting from a 10% migration rate would result in 0.8% growth in agricultural output, and a 20% migration rate would result in a growth rate of 1.6%. Even with optimistic estimates of return to scale, it is evident that consolidation, on its own, is unlikely to bring very high returns in terms of yields or labour productivity.[14]

Table 6: Effects of land consolidation resulting from migration

	No migration		Migration of 10%		Migration of 20%	
	Average land holding size (hectares)	Growth resulting from consolidation	Average land holding size (hectares)	Growth resulting from consolidation	Average land holding size (hectares)	Growth resulting from consolidation
All Ethiopia	0.9	0%	1	0.8%	1.12	1.6%
Deficit areas	0.57	0%	0.63	1.18%	0.71	2.36%
Surplus areas	1.38	0%	1.53	0.02%	1.72	0.04%

Considerations in achieving the growth potential

The results suggest that contrary to perceived wisdom, there is no evidence that smallholder land consolidation is likely to have substantial benefits at present. It is quite possible that increasing the scale of family farms may facilitate growth by encouraging a fundamental change in practices and technologies that increase yields (if, for example, larger farms are more able to adopt new

[14] As Allen (2008) in his background note for this study discussed, this result is very similar to the impact of the 'enclosures' in 17th-18th century England, with some but not large impacts on land productivity.

technologies or crops and use inputs), but the type of analysis that has been carried out abstracts from this and thus cannot make predictions about what such a growth impact may be. This is an important area in which further research is needed.

It is also important to distinguish the simulation carried out here from any discussion of the virtues (or not) of large scale commercial farming. Large scale commercial farming would tend to involve not only substantially larger farm sizes, but also typically involve substantial capital and technology investment, making the underlying technological relationship not comparable to those of peasant smallholder agriculture. Statistical analysis of peasant agriculture data can thus not detect the relevant regularities related to large scale commercial farming, as this represent a very different set of technologies and practices.

What is the scope for encouraging and expanding large scale commercial farming, involving either domestic or foreign capital? At present, at least two vibrant examples of commercial agriculture are spreading: the spread of extensive farming in the North-western parts of the country (with crops such as Sesame) and the highly intensive farms for horticulture (vegetables and more recently, flowers). How should they be considered in the context of the overall growth and commercialization of smallholder agriculture? While a detailed analysis of large scale commercial farming is beyond our scope, some comments can be made on their role, in the context of our overall framework. At present, the efforts towards large scale commercial agriculture are taking place in apparent isolation of the need to stimulate growth in smallholder agriculture; some appear to consider it as a competing source for land and effort, and therefore misguided. Neither seem correct views, at least a priori.

First, the analysis in Dercon and Zeitlin (2009) emphasised that the nature of the Ethiopian economy required, at least in the current early parts of economic transformation, a continued strong focus on increasing food output, as a factor in maintaining a low urban cost of living and facilitating growth in other sectors. Given the landlocked nature of the Ethiopian economy, and the related high costs of imports, large scale commercial agriculture could offer alternatives, and should not be limited to export crops per se. This would particularly be the case in areas not very suitable for smallholder agriculture, so the competition for land is relatively limited, in particular areas where high sunk costs (such as high land clearing costs, or need for irrigation or other infrastructure investments) or other conditions (such high seasonal malaria or trypanosomiases risk) make settled smallholder agriculture less feasible.

Secondly, stimulating the introduction of ‘islands’ of commercial agriculture within smallholder agriculture could also have substantial externalities on smallholder agriculture. Contract farming (outgrower) arrangements could stimulate strong productivity growth in the form of learning or other external effects, via the introduction to new technologies, quality control techniques and new high value crops. Incentives could be put in place to encourage interactions with smallholders or farmers’ cooperatives by these commercial farms. Furthermore, commercial agricultural islands of sufficient scale will be well placed to invest in marketing, transport and other elements of the value chain, as these are activities with substantial fixed costs that cannot be easily borne by smallholders or their organization providing further externalities for local smallholder farmers. Such a model would provide a direct but market-based mechanism to stimulate the transformation towards more commercialized smallholder agriculture.

Fostering such a process will need to go beyond the current rather protected and high-incentive and discretionary treatment of the current success stories, not least in horticulture. Evidence from other parts of the world strongly argues against stimulating large scale commercial agriculture via extensive state or public-private interaction, although there are some remarkable success stories, such as the public-private partnerships in Brazil (Binswanger et al. (2008)). Both the establishment of commercial agriculture islands in smallholder areas and the expansion of large scale agriculture in non-competing land areas will require a well defined and transparent regulatory framework for investment, moving beyond discretionary policy making.

At present, there is little systematic work on the scope for larger scale commercial agriculture, not least in terms of the opportunities it may offer for overall transformation of smallholder agriculture as well. Such work would be urgently needed.

4. The International Dimension: the Role of Openness

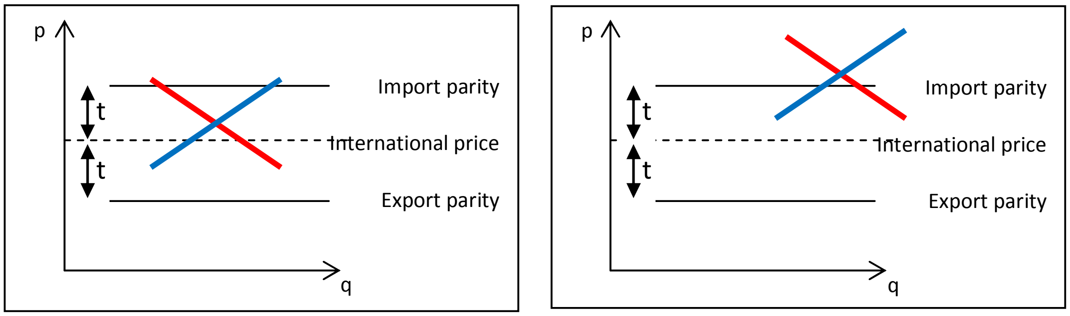
Economic incentives for yield growth by farmers are directly linked to the prices for input and outputs they face. In the next section, we will focus on the factors determining the costs of transacting in these markets, by studying their functioning and performance. The cost of transacting in output and input markets will also determine the degree to which Ethiopia's economy can be considered open or closed for a given good, affecting consequently the nature of price formation in that market, and role international prices can play to offer incentives or disincentives to production.

Figure 7 indicates this for a fictional good (making the assumption that the domestic market is small relative to the world economy, i.e. the country is a price taker). The dotted line indicates the international price for a good. The import parity bound is given by this price plus *t*, the cost of moving goods from the domestic market to the international market, whilst export parity is given by the international price less *t*. The domestic demand schedule is depicted in red, and the domestic supply schedule is depicted in blue. When these cross within the parity bounds the price of the good is determined by local market conditions and changes in domestic demand and supply determine the price of the good (Figure 7a). Were these schedules to cross above the bounds (Figure 7b) the price of the fictional good will (abstracting from trade barriers or constraints in other markets, such as foreign exchange) be determined by the import price (and similarly, by the export price were they to cross below the export parity price. The import and export parity prices thus offer some stability to prices, as they set a floor as to how high or low a price can fall. In setting a floor they also put a limit to how high incentives on offer for production can be (this is also discussed in Dercon and Zeitlin 2008).

The magnitude of transportation costs (in turn determined by port efficiency, the quality of roads, the cost of fuel and the degree of competition among transporters and traders) determines how wide the band between import and export parity is. For a landlocked country such as Ethiopia the band between import and export parity can be quite high, causing prices to be determined by local market conditions, for a wide range of prices.

Figure 7: Openness and price determination

a. Prices in a closed economy **b. Prices for a net import good**

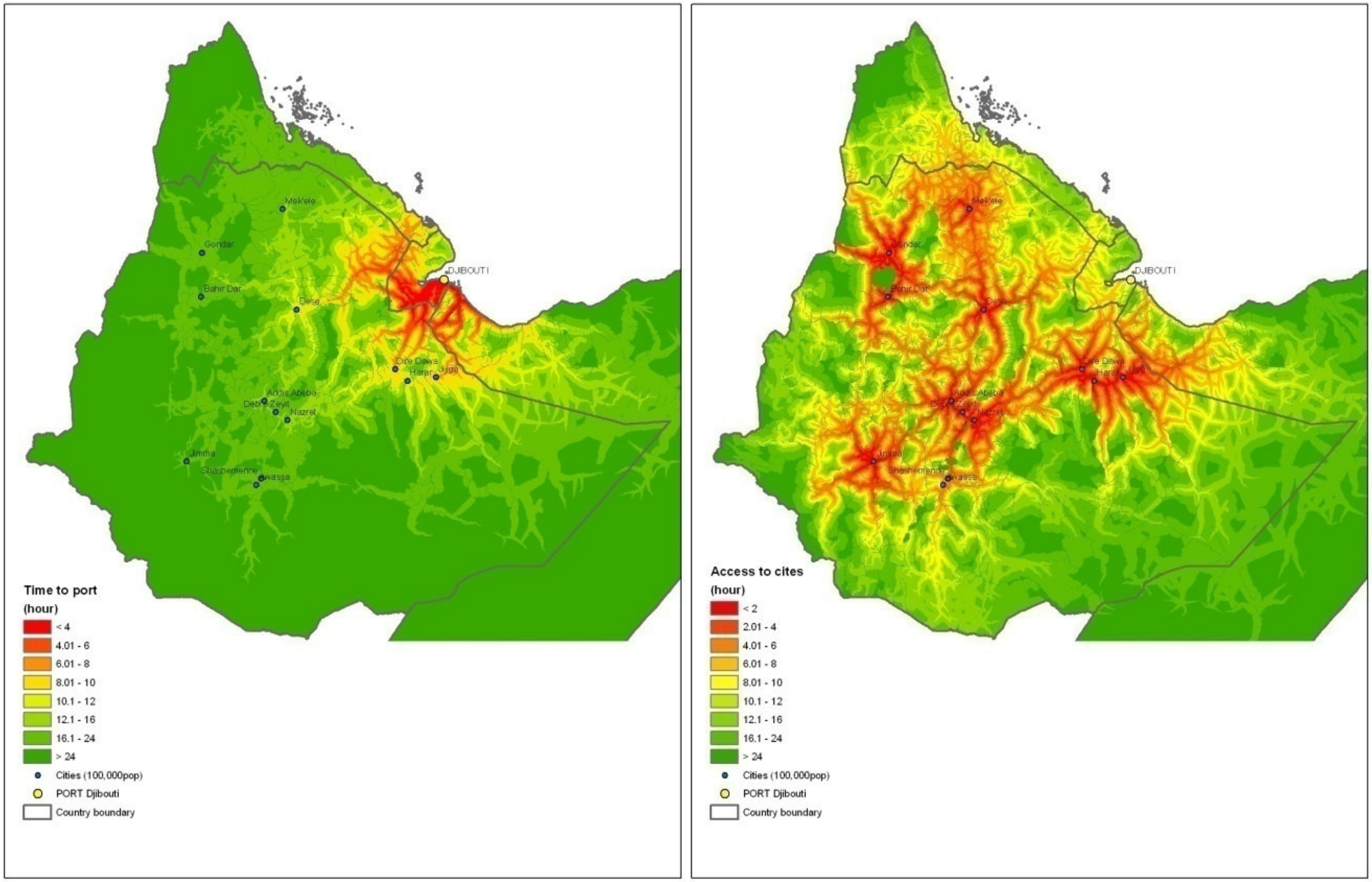


For goods that are imported or exported, proximity to the port is an important measure of market access, whilst for markets that are essentially closed proximity to domestic centres of demand (cities) becomes more important. This has quite different implications for determining areas of high and low market access as indicated in Figure 8. Figure 8a maps time taken to travel to Djibouti port, whilst Figure 8b maps time taken to travel to towns of more than 100,000 people. Heterogeneity of agricultural potential combined with market access is expected to drive area and yield expansion where this is possible, as discussed in Chamberlin et al (2006). Figure 8 indicates that areas of high market access will vary depending on whether the good is an export good or is produced to meet domestic market demand.

The insights from Figures 7 and 8 can be combined further, as wholesale markets for cereals are typically in these large towns. Trade in agricultural produce typically has to pass through these towns towards other areas or ports, and as Figure 8a shows, these distances can be considerable. They will bring export parity prices faced by farmers further down, but also depresses the relevant import parity price, so that overall prices and therefore the incentives to produce may be considerably lower than those implied at wholesale markets.

Figure 8: **Market access**

a: Access to export and import markets **b: Access to domestic centres of demand**



Evidence to date

Figure 9 and Figure 10 present updated import and export parity bounds for maize and wheat using data from Rashid and Dorosh (2009). The import parity bound is calculated for the cost of importing maize or wheat to Addis Ababa from Djibouti port, taking the price at Djibouti as given by the US gulf price plus the cost of shipping to Djibouti and insurance (CIF Djibouti), the export parity bound is calculated for the cost of exporting maize or wheat from Addis Ababa to Djibouti port.[15] The graphs show a wide band within which cereal prices are usually located (with the exception of periods of time in 1999/2000 and 2008 when domestic prices rose above import parity), causing local market conditions to determine prices. The wide band created by high transaction costs causes local market demand and supply conditions to determine the price for a wide range of prices. The band increased substantially towards the end of 2008 with the reduction of fuel subsidies increasing the cost of transporting goods from Djibouti. The limits to trade that high transportation costs impose, thus contribute to highly volatile cereal prices, as have long been observed in Ethiopia. A similar story can be told for prices within any given regional market: when the costs of transporting between domestic markets is high (as is often the case), local market prices will be more volatile than when transportation costs are lower.

The graphs also show that there is a distinct possibility of regime change, with Ethiopia becoming effectively open to profitable imports, as well as profitable exports in quick succession. It is worth to give a brief commentary on each of Figure 9 and Figure 10. Figure 9 suggests at least two periods when imports should have taken place to use arbitrage to bring wheat prices back to parity prices: in 1999/2000 and in 2008. Wheat prices remained substantially above import parity during the second half of 2008. This also shows that mechanisms for private food imports appear not functioning efficiently (possibly related to relative unpredictability of food aid in the form of wheat), but also that the most recent part of the food price increases is much more related to problems of trade (possibly induced by foreign exchange shortages and derailment) than the high international prices. Domestic wheat prices fluctuations in the latter half of 2008 did not reflect international price movements, in spite of being above import parity. The import parity price should put a limit on how high prices can rise (important when considering the adoption of new technologies), but the graphs suggest that in practice this constraint is not always very real.

Maize prices have also fluctuated more than international prices, but mostly within the bounds of import and export parity prices, which relative to the wholesale price is relatively high. Occasionally, the import parity bound was reached making it just about profitable to import maize, typically near the start of the Kiremt rains, just before the new harvest, as would be expected. Again, the latter half of 2008 provides an exception to this pattern, as domestic maize prices were much higher than import parity during this time. At the lower end of the price band, the harvest of 2001/02 is a very interesting phenomenon in this respect. That particular year, the harvest was surprisingly good, and as maize is even in rural areas not a preferred crop, it translated in a very high marketed surplus, flooding the market. Prices halved compared to the year before, and exports took place, but at low prices. In Dercon et al. (2006), using the ERHS, it was found that farmers reported serious hardship

[15] Prices are in constant 2005 US dollars. The cost of transporting from the US gulf to Djibouti is taken as a linear growth from $25 before January 2004 to $50 in August 2008 and the cost of transporting from Djibouti to Addis Ababa is taken as a linear growth from $60 before January 2004 to $85 in August 2008. These figures correspond to transaction cost estimates in WFP (2007) and Dorosh (2008).

due to the collapse of prices, on a scale of the drought the subsequent year in other areas. As maize is grown widely, including in more remote areas, farm gate prices would by implication have been extremely low, explaining why some reported that they could not even sell maize in that year. In general, it is very difficult for maize to be exported as the export parity price is so low, but this is perhaps more possible for wheat. However, this shows clearly the constraints of aiming to stimulate food production in a landlocked country.

Figure 9: Import and export parity, and wholesale prices for wheat (Addis Ababa), January 1998 to November 2008

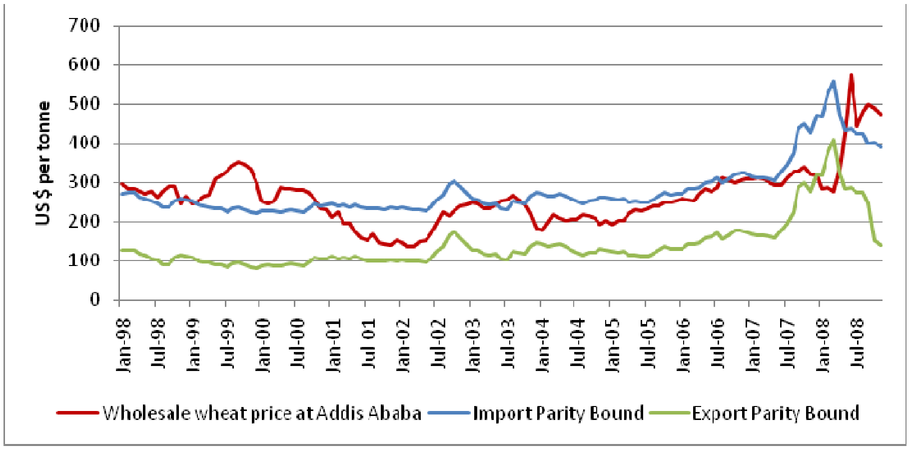
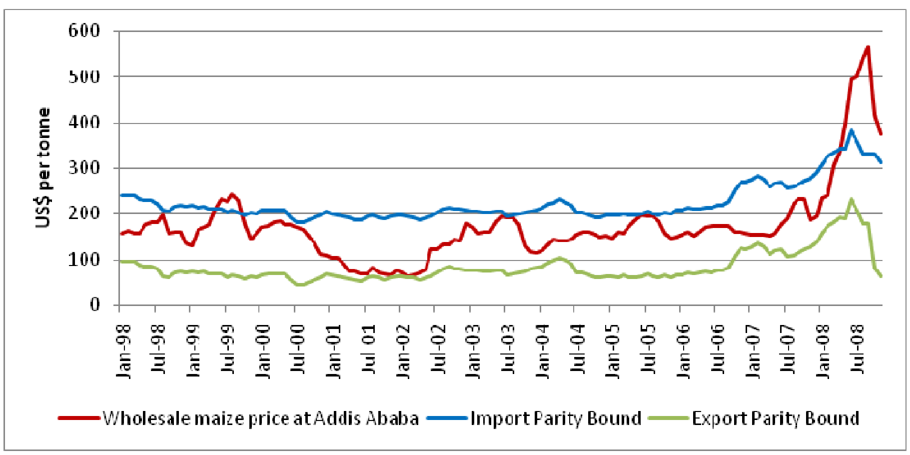


Figure 10: Import and export parity, and wholesale prices for maize (Addis Ababa), January 1998 to November 2008



Thus far we have considered import and export parity bounds for Addis Ababa. Different regions of Ethiopia experience different import and export parity bounds based on their location. For areas to the south and west of Addis the export-import parity bounds can be expected to be higher and for areas closer to Djibouti the import-export parity bounds can be expected to be closer. To consider these two examples we consider the case of Desse and Jimma for wheat (Figure 11) and maize (Figure 12). [16] Desse is a major market located on one of the trade routes from Djibouti to Addis

[16] These graphs use information on the cost of importing wheat and maize from WFP (2007). The cost of transporting a tonne of wheat from the US gulf ports to Djibouti was taken as $40 (including insurance) and the cost of port handling and transportation to Addis Ababa was taken as $75. These were the costs in July

Ababa (via the border crossing at Galafi) and Jimma is a surplus market for maize located 350km to the south west of Addis Ababa. The import-export parity bounds are much closer for Desse than they are for Jimma, and as a result the wholesale market price for wheat oscillates slightly above and below the import parity bound. In Jimma, it was only in mid 2008 that the wholesale price for wheat rose above import parity. Prices stayed within the bounds for maize for both Desse and Jimma until 2008. Note nevertheless how low the export parity price for maize in Jimma appears to be. Smallholders in areas such as near Jimma grow relevant amounts of maize, but in good years, such as in 2001/02 it would barely have been worth it to harvest the crop for sale, resulting in considerable losses.

Figure 11: Import and export parity for wheat in Desse and Jimma, July 2005 to August 2008

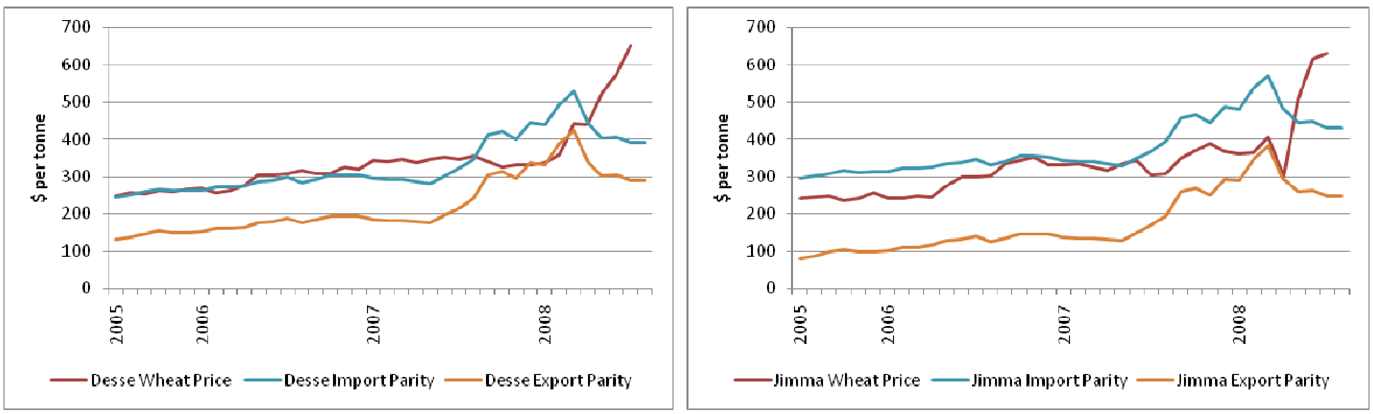
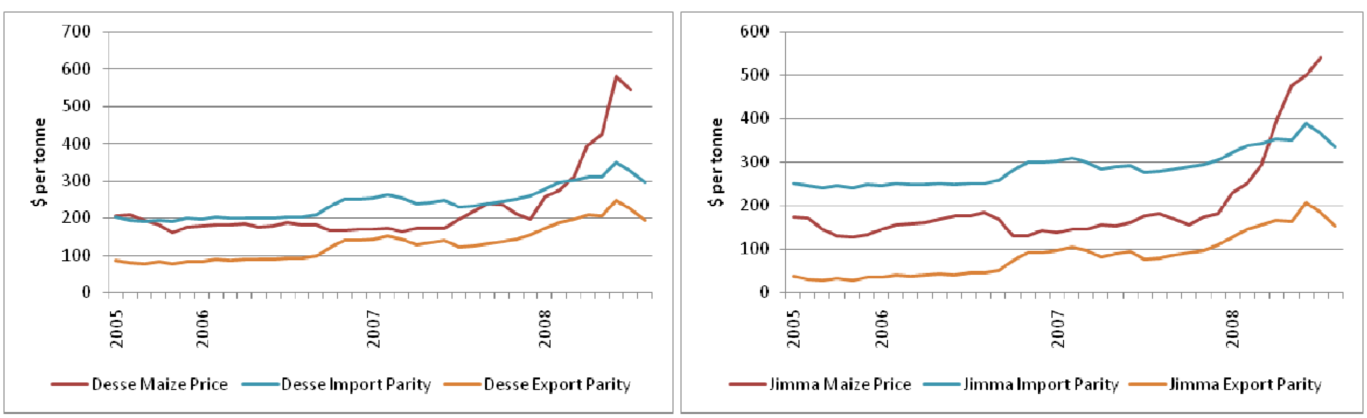


Figure 12: Import and export parity for maize in Desse and Jimma, July 2005 to August 2008



2006 and it should be borne in mind that these costs would most likely have been lower in July 2005 when the time series began and higher in August 2008 when the time series ended. The cost of transporting to Desse was calculated by pro-rating the transport component of the Djibouti-Addis Ababa costs and calculating the cost to Desse. The cost of transporting to Jimma was calculated as the cost of transporting to Addis plus an estimated cost of transporting from Addis to Jimma, estimated using estimates based on trader survey analysis in Hill (2008).

The relative magnitude of the export-import parity band depends on the transport cost to value ratio of a given good. For goods with higher transport cost to value ratios the relative magnitude of the band is lower. Table 7 provides information on the transport cost to value ratio for a number of goods. The ratio is much lower for crops that are exported, such as Niger seeds and coffee, than for maize and wheat.

Table 7: Transport cost to value ratio

Crop	**Median retail price in 2005-6** (Birr per tonne)	**Bulkiness** (m^3 of one tonne)	**Transport cost in December 2006 as a percentage of value (%)** (Addis Ababa to Djibouti, including port handling charges, costing 471 Birr per m^3)
Maize	1600	1.4	41.2
Wheat (mixed)	2200	1.7	36.4
Chick peas	2700	1.5	26.2
Faba beans	2500	1.5	28.2
Niger seed	4760	1.3	12.9
Sesame	6000	1.3	10.2
Coffee	18000	1.8	4.7

Source: Author estimates, median retail price from CSA, estimates of Djibouti-Addis transport costs from WFP (2007)

Looking forward

Recently, due to rising global fuel needs, the decline in fossil fuel stocks, and the scope for biofuel technologies, cereal and fuel prices have started to co-move. In the last few years, this resulted in rapid increases; currently, a downward spiral has taken place. This suggests two likely scenarios for the future: (i) high fuel costs and cereal prices which make Ethiopia closed in practice, (ii) low fuel costs and cereal prices which make Ethiopia open in practice. In the first scenario trade volumes will be low, or even non-existent, and export potential will be restricted to high-value, low bulk crops, in well situated production areas. Cereal production for the domestic market will profitable, with high cereal prices not inducing imports. As a result, in this scenario, domestic market access would be a strong driver of commercialization, causing areas closer to urban centers to experience more growth. Given high transport costs, more remote areas, even if of high potential, are unlikely to be profitable.

Under the second scenario cereals can be imported into Ethiopia quite cheaply, providing limited incentives for innovation in cereals. However, the production of high value-added crops in agriculture would provide possibilities with urban growth fed by low cereal imports. As the costs of transporting to domestic market centers would also be low commercialization would be relatively more driven by agricultural potential than market access.

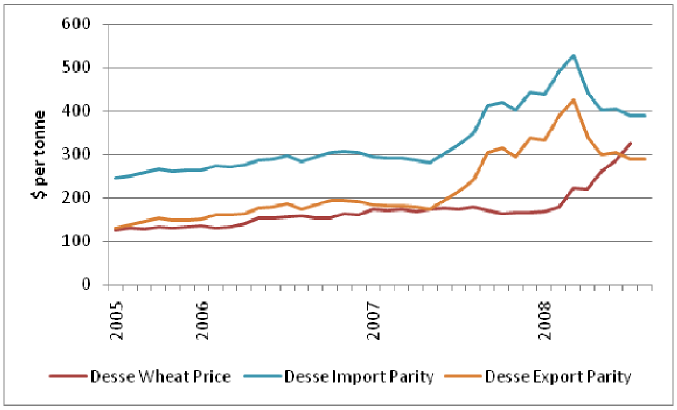
Either scenario would suggest a rather different location and focus of investments. The impact of openness on growth and appropriate growth strategies is thus very dependent on the fundamentals of global markets in oil and food. Either scenario is possible, and, as at present, we may well experience rapid regime shifts (from high to low prices), making strategic investments more difficult to be profitable in a sustained way. Focusing on productivity improvements makes most sense when international prices are likely to remain high, as in that case domestic production can offer an alternative to expensive imports, trying to push prices below import parity, while in bumper years and as long as urban demand is lacking, relatively high export parity prices will offer decent incentives to farmers via exports when domestic prices are low. But this strategy can quickly hit the rocks if international prices are low, so that imports are cheap, exercising downward pressure on prices, while bumper harvests could not be profitably exported at low export parity prices. The result is a *necessity* to complement any policy focusing on land productivity increases with other measures. Stronger urban demand would avoid food prices drop below export parity prices, but it is possible (or, to put it more strongly, it is essential) to affect parity prices directly by reducing transactions costs, such as via better marketing infrastructure, port infrastructure, and a more competitive transport sector).

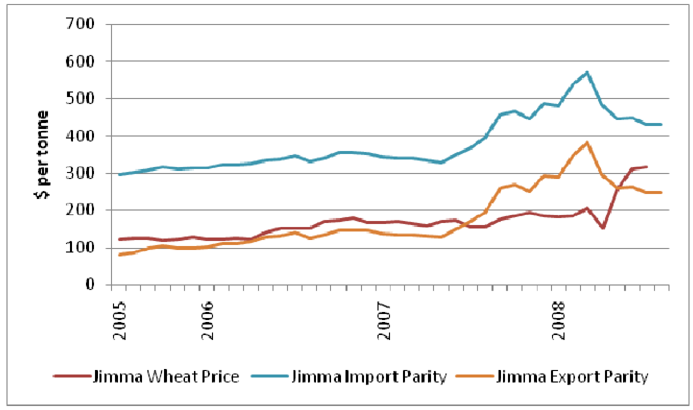
To show this, let us assess the impact of improving productivity (through innovations in seed technologies and improvements in production practices) or reducing transaction costs (through increase port efficiency, road investments or increased competition in the transportation sector) on import and export parity prices.

Figure 13 and Figure 14 consider the case of wheat and maize respectively and assess alternately the impact in Desse and Jimma of (i) improving productivity (such that the domestic price halves), (ii) reducing the costs of exporting and importing by half, and (iii) both improving productivity and reducing the cost of transacting. If either measure results in prices to go below export parity prices, then exports would have become profitable and thereby offering a floor to prices. Similarly, if when domestic prices go above import parity prices, then imports could bring down prices to the parity bound. The figure shows that substantial improvements in productivity would allow Desse to start exporting both maize and wheat, but would not be enough to ensure exports from Jimma of either commodity unless in situations of high world food prices – so that boosting production could result in very low prices for farmers. The second row of panels shows that reducing the cost of transacting without substantial productivity improvements results in increased import competition for cereals (particularly for wheat), providing more downward pressure on food prices when domestic harvests are poor. Substantial improvements in productivity and the cost of transacting reduce the need for imports in relatively poor years, including when international prices are high, but it would also offer a floor to domestic prices via exports including from areas far from the coast, such as Jimma.

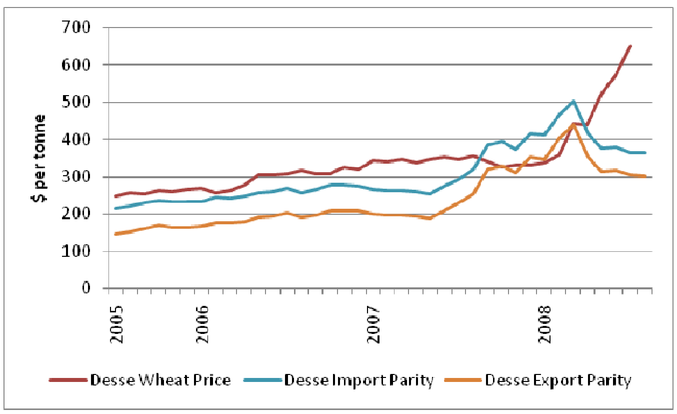
Figure 13: The impact of productivity improvements and transaction cost reductions on openness (wheat)

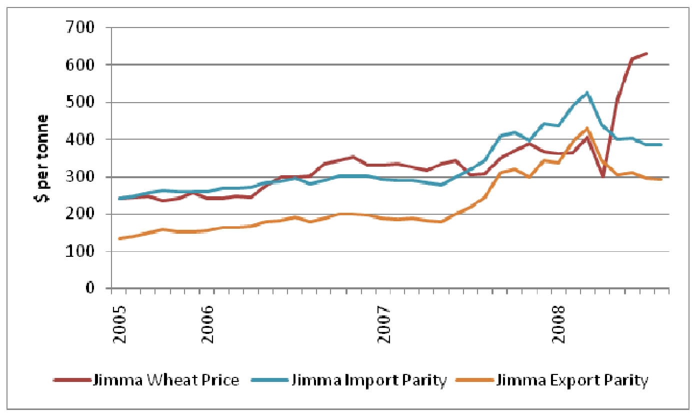
(i) improving productivity



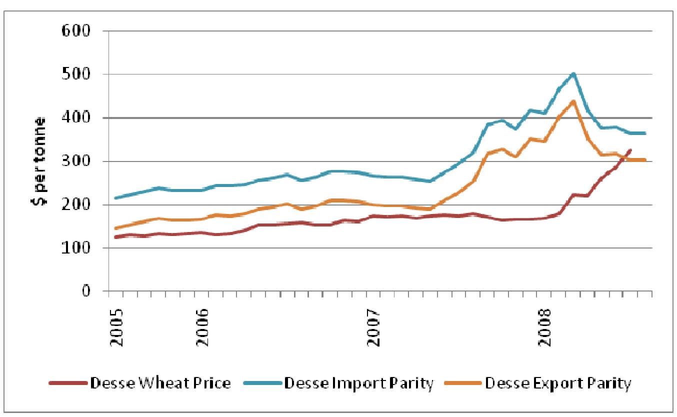


(ii) reducing all domestic and port transaction costs by half





(iii) improving productivity and reducing transaction costs



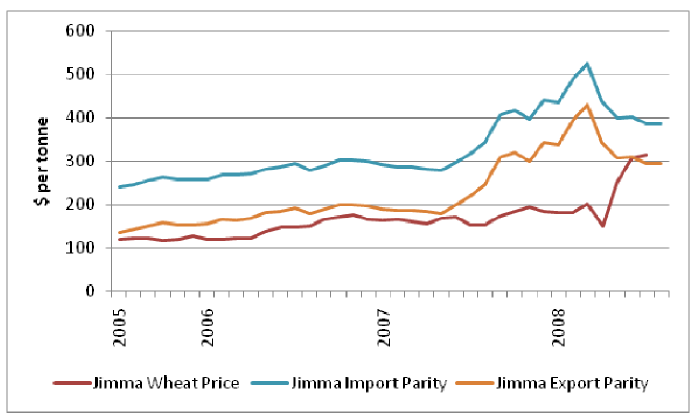
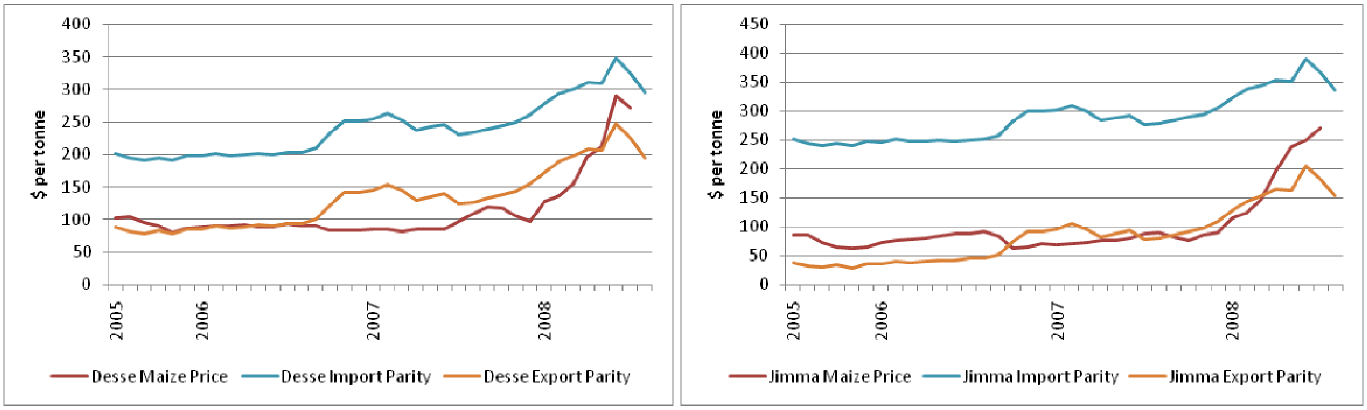
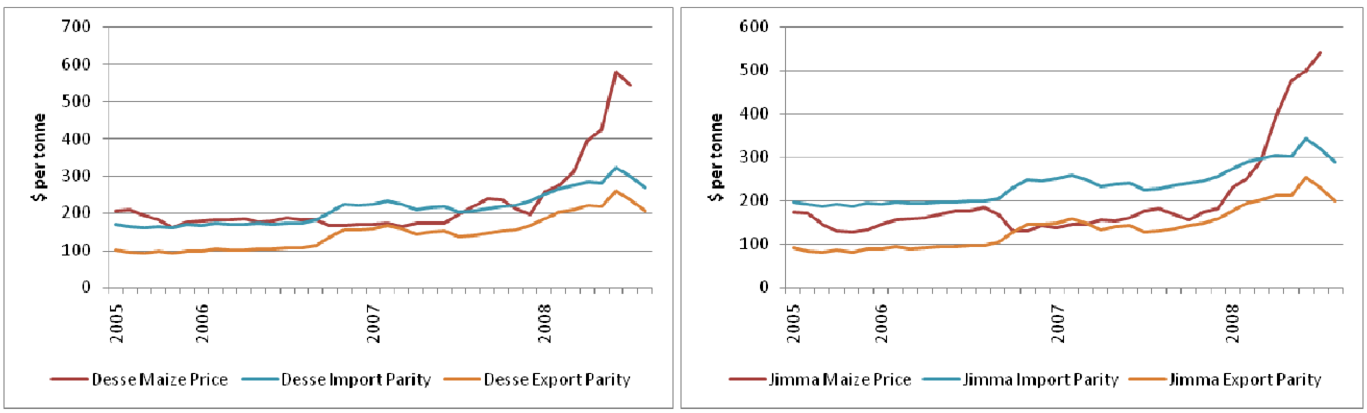


Figure 14: The impact of productivity improvements and transaction cost reductions on openness (maize)

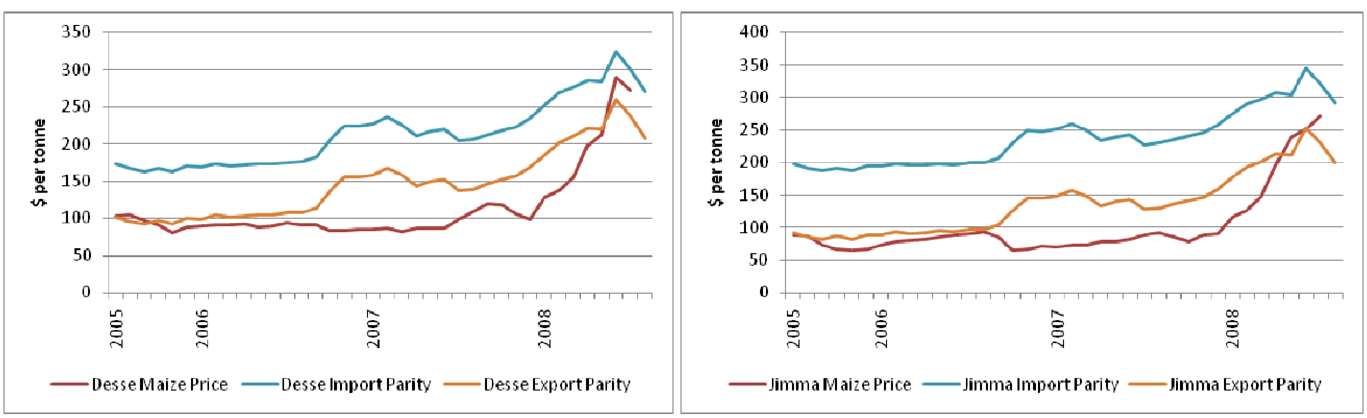
(i) improving productivity



(ii) reducing all domestic and port transaction costs by half



(iii) improving productivity and reducing transaction costs



5. Markets: Institutional Features and Performance

The discussion thus far has first identified the opportunities and constraints on the available technology for rapid productivity increases. One constraint on its adoption is the need for high economic incentives, otherwise widespread adoption is unlikely to be taking place or sustained. Being landlocked, most of these incentives will have to come from domestic markets. International trade offers nevertheless a useful opportunity, as international prices offer a bound on upward and downward pressure on prices; the former is crucial for consumers and growth in other sectors; the latter is crucial for incentives to farmers. Nevertheless, the actual level of economic incentives faced is crucially determined by the transactions costs in the markets for outputs, inputs and other production factors. In this section, we will focus first on input markets, as they need to deliver the crucial inputs for productivity gains, and then on the functioning and performance of output markets. Finally, we discuss key issues related to other factor markets, such as credit, insurance, land and labour.

5.1. Markets for Modern Inputs

Ensuring the adequate and timely availability of high quality inputs at good prices contributes to allocative and technical efficiency. An improvement in the functioning of input markets thus contributes to increased efficiency in agricultural production and agricultural growth. Input markets for cereal production are important for cereal-based agricultural systems such as Ethiopia's, but developing markets that are flexible enough to supply a wider variety of crop inputs becomes increasingly important as crop production diversifies. High-value crop production (such as vegetables and pulses) has been part of the success of commercialized markets in Vietnam, China, Thailand, and India.

Evidence to date

Despite sustained government effort, input use has remained relatively stagnant (as indicated in the data presented in Section 2 and 3). Whilst there are a number of factors that contribute to low input use, on major factor seems to be weak input markets that have not been able to supply farmers with high-quality inputs in a timely manner, especially for seed.

Evidence: Seed

The current seed production system does not meet annual demand for improved seed. Less than 5% of area planted with cereals uses improved seeds; even for maize, it is only about a fifth of area planted with the crop. Most farmers report relying on farmer-to-farmer exchanges or saved seed, for both traditional and improved varieties (Belay, 2004). The state-owned Ethiopian Seed Enterprise (ESE) dominates Ethiopia's improved seed production and distribution—private seed companies including Pioneer comprise 26% of the market, but often their customer is ESE—and since 2004 it has not been able to produce all the seed demanded. In 2004/5 there was an estimated shortfall of 73% (Alemu et al 2007). Limits in the multiplication of breeder seed are a key constraint (Tefera 2006; Otsuka 2008). Increased participation of other companies may help alleviate this constraint. However, although policies favorable to private sector development are in place, there are a number of barriers that limit their involvement. It is difficult for new market entrants to build a distribution network that can compete with that of the ESE's distribution network of cooperatives offering seeds in combination with credit (Spielman, 2008). Additionally, despite the comparative efficiency of the private sector—estimates for one private company suggest they can produce hybrid maize seed for 32% of ESE's costs (Alemu et al. 2007)—it is hard for private sector participants to compete with the subsidized price of the ESE produced seed. Seeds are heavily subsidized as evidence in the much lower ratio of seed to grain price in Ethiopia, 5:1, as compared to the international norm of 10:1 (Spielman 2008); low prices may be good for farmers but not if it is at the cost of rationing supply. It is also difficult for potential market entrants to access finance given the stringent collateral requirements in place for seed companies. Combined, these factors limit the extent to which the private sector can develop to increase the capacity of seed production and distribution in Ethiopia.

There has been a recent effort to encourage the development of on-farm seed multiplication by contracting larger scale farms (for example farms of 5-10 hectares) to undertake seed multiplication. This is an important part of increasing capacity for seed production, but is limited by the need for large scale farms with a sufficient perimeter between land used for seed production, and cultivation of crops of the same type. Additionally land that is used to produce seeds in one year is required to rest for two to three years before being used for multiplication of the same type of seeds again. To the extent that suitable farms can be used for this, a clear transparent regulatory framework and strong seed certification systems can facilitate the development of this industry.

Evidence: Fertilizer

Whilst fertilizer markets do not appear to be operating with overly high transaction costs compared to those in neighboring countries[17]—the import price is between 75-81% of the final fertilizer price—any reductions in transaction costs would improve the profitability of fertilizer usage. The general perception is that the current fertilizer supply system does tend to get fertilizer to the farmers. There are nevertheless problems in ensuring the quality and timeliness of fertilizer supplied (Byerlee et al 2007): almost half of farmers reported fertilizer arriving after planting, a third reported fertilizer was underweight and a quarter responded that fertilizer was of poor quality (Bonger et al 2004). In 2006 a quarter of farmers complained about late delivery and there were reports of supply shortages of Urea (DSA 2006 and EEA/EEPRI 2006).

In particular three key problems in the current system can be highlighted. First, although the market may in principle allow for private competition, in practice, a number of regulations and practices strongly affect entry. Secondly, the import system for fertilizer is maybe functioning but it is unlikely to be working efficiently. Thirdly, the cooperatives are not able to play an effective role at present. We will discuss each of these problems in turn.

[17] Byerlee et al present comparative evidence across a number of countries (p22) for the 2003-5 and show that marketing costs are $107 per ton of urea imported in Kenya compared to $83 per ton of urea imported in Ethiopia. Although they note that retailing costs are not included in this estimate for Ethiopia given these costs are borne by public institutions (extension agents and cooperatives).

First, whilst there has been substantial deregulation in Ethiopia, there are some de facto restrictions that limit the entry of new traders, effectively reducing the contestability of the market. Fertilizer importers are restricted to a small number of firms (the largest of which, AISE, accounts for 50% of the market and is state owned) and cooperatives (more below), due to the high entry costs involved in fertilizer import and the capital intensity of operation.[18] The sensitivity of fertilizer to providing food security also encourages government interference in the operations of fertilizer importers making it a risky business. Many of these importers also dominate wholesale trade, and at the retail level only cooperatives are operational. This contrasts with many other countries in which private input traders operate competitively as retailers often providing advice to farmers as the type and amount of fertilizer needed and its appropriate application. Ten years ago there were a number of private fertilizer retailers in Ethiopia, but most left after a few years. Informal interviews with some of these retailers revealed that they exited on account of not being able to supply fertilizer to farmers who were receiving credit for fertilizer from their cooperative (these farmers had to buy fertilizer through the cooperative), and on account of substantial regulations and government involvement in the sector (DSA 2006). The resulting dominance of the fertilizer market by state actors raises problems, not because the actors are parastatals rather than private operators; but because in such monopolistic and oligopolistic structures, it is crucial that there are competitive pressures on the firms operating. Competitive pressures ensure that the market chains remain sustainable over time and keep on offering good prices to farmers, which is the same as offering incentives to work at lowest marginal cost. Competitive pressure can be encouraged by ensuring entry by new market actors is possible and any implicit or explicit subsidies are made available to incumbents and entrants, state and private companies alike.

Secondly, the current import of fertilizer is very inflexible, based on a long and complex system of demand estimation. Peasant Associations make demand orders ten months before fertilizer is applied (orders are made in August-September and use is in June-July). As a result when farmers come to buy fertilizer they may end up purchasing more or less than they estimated, so they carry substantial risk as decisions have to made before they know their own circumstances or the final price of fertilizer. In aggregate, fertilizer consumption does not change much from year to year, but the amount imported, and held in stock does, suggesting that this long process of demand calculation may not be helpful in determining true market demand.

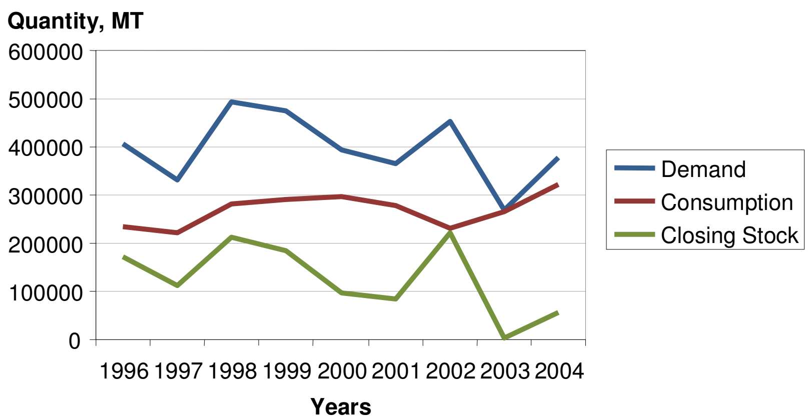
Figure 15 (from DSA 2006) shows that imports and stocks have a much higher coefficient of variation than fertilizer consumption. One could argue that a competitive market may respond to signals of changes in demand more effectively, and could internalize risk more effectively. Furthermore, the long demand discovery process means that drops in the international price of fertilizer (which tend to follow the price of crude oil) cannot be taken advantage to reduce the average import price of fertilizer. This is something private market actors may be able to respond to better (with the right access to credit).

Thirdly, increasingly cooperatives are starting to undertake some of the wholesaling and importing activities previously undertaken by state enterprises and private firms. By 2005 a number of cooperatives were involved in wholesaling fertilizer and nine were also importing fertilizer (DSA

[18] Substantial access to capital is required as a result of regulations including one that states the value of imported fertilizer cannot be used as collateral and one limiting how much a single importer can borrow.

2006). Cooperatives are able to take advantage of the fixed costs involved in procuring inputs ensuring farmers are provided with inputs at lower per unit costs than they would be were they to purchase them individually. In Europe agricultural cooperatives still purchase half of the agricultural inputs purchased (Bernard 2008). However, cooperatives seem to work best when they are actors in the market, rather than taking the place of the market. Cooperatives will not be able to compete with each other for market share given their market is grounded in their geographic base. Currently a number of households choose not to take part in a cooperative even when one is available (83%) and 42% of non-members with direct access to a cooperative in their kebele reported not participating primarily because they viewed the cooperative as ineffective (Bernard and Seyoum Taffesse 2008).

Figure 15: Fertilizer demand, consumption and stocks (From DSA 2006)



The fertilizer supply chain is currently broadly succeeding in fulfilling its function of ensuring that fertilizer reaches farmer at prices reflecting border prices with reasonably low transactions costs margins, despite some documented evidence on inefficiencies. However, the fertilizer market is strongly affected by constraints and regulations, offering limited scope for private sector entry. In the long-run, by affecting entry, these constraints are bound to affect the development of sustainable market institutions and at this stage it would be useful to start a careful assessment of how such market institutions can fostered. This is not a criticism of the fact that key players are linked to the state sector; in fact, if the incumbent were a private operator similar problems could exist. The key is that it is in practice closed off from further entry by constraints and regulations on entry, strongly affecting the incentives for expansion, cost reductions and overall efficiency.

In sum, the limited contestability in the marketing of inputs (through offering advantages to some market players but not available to new entrants) results in marketing chains dominated by an oligopoly of companies and cooperatives with limited incentives for increased efficiency to lower prices, provide better quality inputs or ensure more timely delivery for farmers. The constraints in current distribution systems that this results in will become more intense as crop production diversifies and requires an increase in availability of fertilizer, seed, loans and information for non-cereal crop production. Developing efficient fertilizer and seed markets for cereal crops in which market actors have the right incentives to provide inputs at the lowest marginal cost will aid the development of good input markets for other commodities.

Looking forward

Improving the functioning of input markets is essential to ensuring the availability and adoption of new production technologies. As such it has considerable implications for growth. However, the impact on growth is conditional on the growth potential of existing technologies. To illustrate both the growth potential from improving input markets and the need for simultaneous improvements in technologies and production practices, we consider the profitability of fertilizer use. The impact of fertilizer on yields in quite heterogeneous, varying with location (Demeke et al 1997), whether it is used in combination with improved seeds and farm-management practices (see Section 3.1 for a discussion), and also with the weather in a given cropping season. Smaller yield improvements are realized for lower and higher rainfall levels. Christiaensen and Dercon (2006) show how yields vary with the weather for the ERHS panel villages (Figure 16a). The variability of yield increases from one year to the next makes fertilizer adoption a risky proposition for rural households. Once the price of fertilizer and crop output is taken into account the returns from using fertilizer, are not always higher than not using fertilizer (Figure 16b). This finding corroborates the low returns to fertilizer use reported in Dadi et al (2004) and World Bank (2006), and helps to explain why the proportion of households using fertilizer has been quite stagnant.

Although the nominal price of fertilizer has increased in recent years, the real price has stayed quite constant, and real food prices have risen. As a result, as Figure 17 shows, fertilizer use is not less profitable now than it was a few years ago. We consider how improvements in input (or output) markets would alter this. In Figure 18a we indicate the profitability of fertilizer use (under existing production practices) were the fertilizer to output price ratio to improve by 50% falling from its current value of 114 to 75, a profitability ratio not seen since 1994-5 (Demeke 2008). Even with such an improvement the profitability of fertilizer is not very high (the expected return is negative) and encouraging greater adoption under these prices and production practices will only result in income growth under good rainfall conditions. We also indicate the profitability of fertilizer use were the ratio to improve by 100% falling to 55 (Figure 18b). At this level of profitability fertilizer becomes profitable in nearly all rainfall conditions, but again expected profitability is not large.

Changing the fertilizer to output ratio by this amount would require either: (i) a substantial reduction in the fertilizer price through improvements in the existing import and marketing of fertilizer, (ii) a substantial reduction in the costs of transacting in the cereal market, or (iii) a substantial increase in the output price of cereals (which are already quite high).

Alternatively a substantial improvement in the efficiency of the use of fertilizer (training in the amount to apply in different soil and weather conditions) or use of fertilizer with improved production practices or improved seeds could substantially improve yield gains realized from fertilizer application (see Section 3.1) thereby increasing its growth potential. An important factor in determining input use is the effectiveness of extension agents: Bonger et al (2007) found that poor extension services were ranked as the top reason for non-adoption. Analysis of the ERHS panel shows that increased access to extension services resulted in accelerated growth: receiving a least one visit from an extension agent raised a household's consumption growth by 7% (Dercon, Gilligan, Hoddinott and Woldehanna 2006).

Figure 16: Yields and returns to fertilizer use

Using data from Christiaensen and Dercon (2006) on crop yields with and without fertilizer at different deciles of rainfall (estimated using ERHS 1999)

a. *Yields (kg per hectare) with and without fertilizer*

b. *Net return in Birr per hectare using 2008 prices*

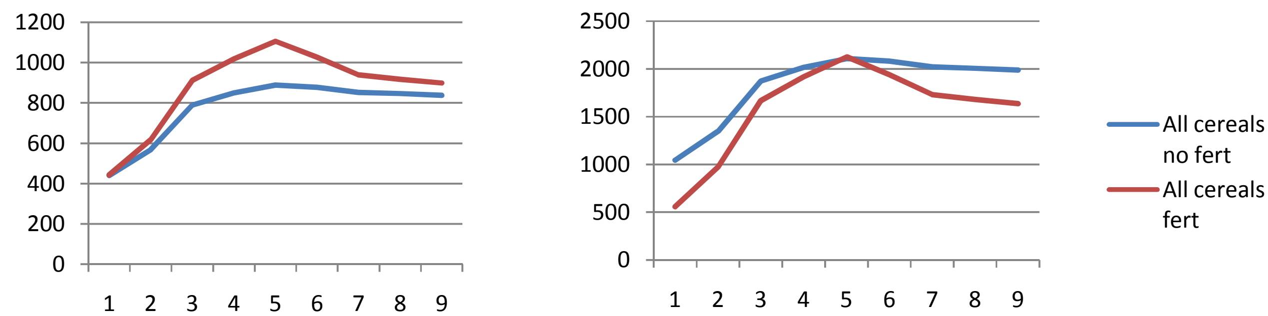
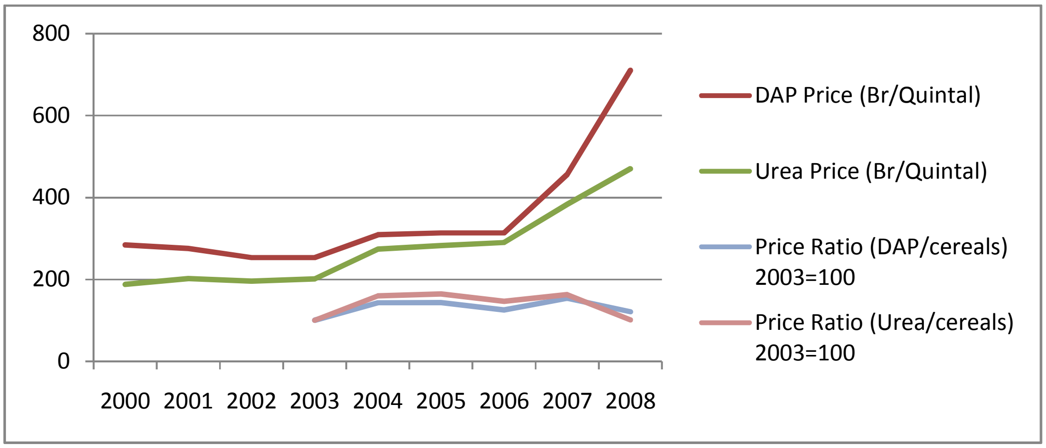
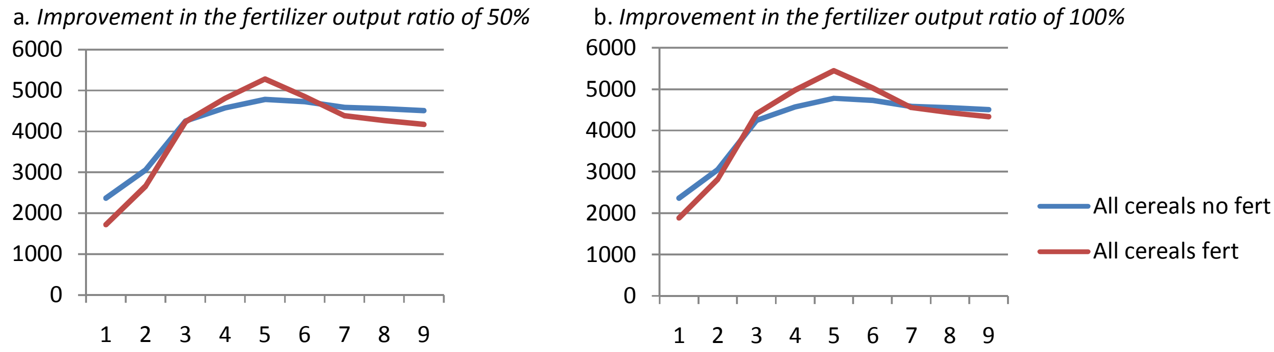


Figure 17: Trends in fertilizer prices and profitability



Source: Using data from Spielman 2008b

Figure 18: Profitability of fertilizer production under improved fertilizer to output price ratios
(Net return in Birr per hectare, at different deciles of rainfall)



Considerations in achieving the growth potential

Section 3.1 has shown that the highest returns from modern inputs are obtained if fertilizer, seeds and changing practices are all applied together. Currently, seed is lagging strongly, and should be a priority. Extension services are being expanded, but little or no effort is in place to properly assess whether they are having a real impact and are optimally used.

A detailed discussion of the current constraints to efficient input markets and possible scenarios by which input markets could be made more efficient (along with a discussion of the sequencing of reforms) is laid out in Spielman (2008). The study on fertilizer and seed markets conducted by DSA (2006) also provides a number of policy options to improve input markets. The proposals include:

First, action to ensure that there is contestability of these markets, by which we mean that it should not just be that the private sector can legally enter, but also that a competition policy is in place whereby entry is positively encouraged, or at least not hindered by offering specific advantages to incumbent (public or private) firms or regulations that make entry too costly. One measure would be to reduce the entry costs to entering in the import market by allowing fertilizer to be used as collateral for loans to import fertilizer, and addressing other regulations that increase the amount of capital required to operate. Similarly entry costs of entering seed production could be reduced again by improving access to finance and a clear regulatory framework without excessive costs related to quality control.

Second, encouraging the development of private input retailers by improving access to credit and access to wholesale traders for private traders. An important part of developing effective input markets is related to access to credit for the purchase of inputs. This is considered further in the next section.

As discussed, improving extension services is one way in which input use can be made more efficient. There have been substantial investments in the extension services provided. It is important to evaluate these reforms to learn what has improved and what has not. In particular, it is important to address the serious capacity constraints in training new extension workers that have arisen as a result of the training and retraining implied by the recent expansion of extension services. In addition to increased resources for training extension workers, the type of skills and training provided through current curricula should perhaps also be evaluated (Spielman 2008, Davis et al 2007). Developing skills in innovation and problem solving will become increasingly important as extension services are required to provide more varied advice on a number of different crops and activities such as marketing and processing (as can be expected if agricultural production encompasses more crops and a greater degree of value addition).

5.2 Output Markets

The agricultural growth experience of China and medieval Europe both evidence the importance of high prices in encouraging farmers to achieve increases in productivity via adoption of new techniques and inputs(see Park (2008) for a discussion of this for China, and Allen (2008) for a discussion for medieval Europe). Reducing the cost of transacting is essential in ensuring that increased consumer demand, and the rising prices it results in, causes an increase in the prices farmers receive for their produce. High transaction costs in crop marketing increase food prices for consumers and reduce prices received by producers for the crops they sell. High transaction costs also create a price range in which an agricultural household (or a region) will choose to neither buy nor sell a good, causing households (or regions) to be autarkic and not integrated in trade (Key et al 2000). In these cases households do not specialize and instead produce the crops they will consume. Food markets that exist are very thin, and the subsistence strategies of farming households are reinforced by the price risk that results from thin markets (Fafchamps 1992). Finally, transactions costs to bring produce to the border are also crucial in determining the floor price for farmers implied by the export parity price, which offers via exports some protection against price declines when harvests are improving. Similarly, transactions costs affect the maximum prices consumers would face during harvest shortfalls, via import parity prices.

Investments in crop marketing to reduce the size of transaction costs allows efficiency gains to be realized from higher and less volatile prices, as well as relatively higher farmgate and lower consumer prices. Policy interventions that allow the scale of trading to increase may result in efficiency gains. The widespread presence of fixed costs of transacting in agricultural markets (Key et al 2000), and the economies of scale and specialization that exist in the processing and marketing of high-value agricultural produce (Hayami 2006), can cause increasing returns to scale to be present in marketing and processing. This depends on the context as a number of studies have found little evidence of returns to scale in market institutions that dominate cereal trade in African countries (Fafchamps et al 2005).

Food consumption patterns change with the income level and urbanization of a country, requiring output markets to adapt. Evidence shows that as income levels increase and as urbanization rates grow, demand for high-value agricultural products, such as fruit, vegetables, animal products and meats, increases (Gulati et al 2007). Developing markets for both cereal and non-cereal foods is thus important. One feature of high-value crops such as vegetables and fruits is that the share of the final price received by farmers is often much lower than the share of the retail price that farmers would receive for grains and cereals (although the absolute producer price will usually still be much higher).

The reason for this much lower share (information from competitive markets in East Asia suggests this share is on average about 30% for fruit and vegetables compared with about 70% for cereals) is that there is much more value addition possible for these high-value commodities than for grains. Unlike production, it is generally believed that there are increasing returns to scale in the processing and retailing of agricultural commodities. Encouraging investment in these activities is thus likely to be a substantial source of growth.

Evidence to date

Cereal markets appear to be reasonable well integrated at the moment. A number of studies have indicated that the spatial integration of markets in Ethiopia (at least for cereal crops) improved during the 1990s (Dercon, 1995; Negassa and Jayne, 1997; Amha, 1999, Gabre-Madhin and Mezgebou 2006). Although there may still be some markets that are not integrated (as suggested in Gabre-Madhin and Mezgebou 2006, and Negassa and Myers 2007), prices tend to move together and local supply shocks (in the form of food aid) do not have an impact on local prices as one would expect in segmented markets (Dorosh, Rashid and Seyoum Taffesse 2008).

However, the cost of transacting both internationally and between domestic markets remains substantial, so farmers' prices remain relatively low. As discussed before, the high costs of international trade render the Ethiopian economy essentially closed to trade in a number of commodities for a wide range of domestic prices, and the high costs of domestic trade are evidenced by the low share of the market price that farmers receive for the goods they produce. Table 8 presents estimates of the share of the Addis Ababa retail price that farmers receive when selling their crops. Shares were estimated using CSA data for 2007, and the EDRI-IFPRI Cereal Marketing Survey and suggest that farmers receive between 59% and 69% of the Addis retail price depending on the crop. However, other estimates are lower. For example, Gabre-Madhin and Mezgebou (2006) estimate farmers' share of the market price, as 30%. Similarly, Love (2000) estimated that farmers receive 60% of the auction price for coffee. As a point of comparison in Vietnam the share of the retail price farmers received remained constant throughout the late eighties and the nineties at 71% in the South and 83% in North (Goletti and Minot 1997).[19] The share of the exporter purchase price received by farmers for coffee is 80% in Uganda (Fafchamps and Hill 2008). As a result of higher transaction costs the marketed share of food-grains remains quite low (about 30%, Minot 2008) compared with sales of paddy rice in Vietnam estimated at 60% in the mid-nineties. Even though circumstances across countries are not directly comparable, this evidence suggests much scope for reducing transactions costs.

Table 8: Producer prices for cereals as a share of Addis Ababa retail prices, January and February 2007

	Share (%) of Addis Ababa retail price received by farm

[19] Even taking the farmer price in the surplus south as a share of the retail price in the deficit north, the share of the price received by Vietnamese farmers is still much higher than that received by farmers in Ethiopia at 55%.

	households
Average for cereals	63
Teff	67
Wheat	69
Maize	53
Barley	64
Sorghum	49

Source: Producer prices from EDRI-IFPRI Cereal marketing survey, Addis Ababa retail prices from CSA

An analysis of price volatility in markets for Teff, Wheat and Maize suggests that price volatility remains quite high. For these crops, the coefficients of variation of monthly nominal prices range from 0.175 to 0.302 in the period 2001-2003 (Gabre-Madhin and Mezgebou 2006). Weather-induced variation in production of these commodities contributes to a high coefficient of variation, as does the relative inelasticity of supply caused by high transaction costs.

High transaction costs do not appear to be the result of abnormal profits on the part of crop traders, as net margins are quite modest (12% compared to 50% on other African countries, Gabre-Madhin and Negassa 2004), but most likely arises as a result of the high costs of transporting goods and the length of the supply chain which is estimated to be longer than in other African countries (Table 9).

Table 9: Estimates of length of supply chain for food crops (mainly cereals)

Country	**Length of supply chain (number of traders through whom good passes between farmers and consumers)**
Ethiopia	4
Benin	3
Malawi	2
Madagascar	2

Source: Estimate for Ethiopia is from EDRI-IFPRI 2008 cereal trader survey
Other data is from Fafchamps et al (2005)

Transport costs comprise 72% of the transfer costs between deficit and supply markets (Gabre-Madhin 2004). The mean per unit costs of transportation were found to be $0.12 per tonne per kilometre among cereal traders (Hill 2008), which are higher than the range found for transport costs in Sub-Saharan Africa of $0.06-0.11 per tonne per kilometre (Teravaninthorn and Raballand 2009), although this might be on account of the fact that the latter number focuses on major transport corridors where vehicles tends to be larger, and distances travelled, longer, allowing per tonne per kilometre costs to be lower. Indeed transport costs in Ethiopia are lower for longer routes (Table 10), and may be lower on more common routes, such as from Addis to Djibouti.[20]

Table 10: Transport costs on selected routes

Route	Distance (km)	Median Cost (US$ per tonne per km)	Mean Cost (US$ per tonne per km)	No. of observations
Zeway-Meki	30	0.17	0.19	13
Asebteferi-Nazarete	213	0.09	0.10	12
Gutin-Dessie	820	0.05	0.08	6

Source: Data are from EDRI-IFPRI 2008 cereal trader survey, routes are selected as the three routes with the most observations and a low standard deviation of reported per unit per kilometre costs.

Substantial investments in infrastructure in recent years have been made with the aim of reducing transportation costs. Comparing traders in similar markets in 2002 and 2008 suggests that these investments have *not* resulted in reductions in the cost of transacting (the real price difference remained the same[21], and the recorded costs of transacting increased) or the share of trading costs represented by transport costs (Table 11). This is most likely because these investments have acted to offset the 35% increase in the real price of fuel during this time. To further test whether there had been any change in transport costs, the cost of transporting one quintal per kilometre was regressed on distance (in case there are decreasing costs of transporting with distance) and a year dummy. The year dummy was insignificant; suggesting the cost of transporting has not changed. However when transport costs are deflated by the costs of fuel, there was a substantial reduction in the cost of transporting during this period, suggesting increased efficiencies in transportation as a result of improvements in infrastructure or increased competition in the transport sector (Hill 2008).

Table 11: Comparing costs of trading between 2002 and 2008

	2002	2008	p-value for test of significant difference
Real price differential (median, Birr/quintal)	*10*	*10*	*0.725*
Gross margin rate (median)	*1.04*	*1.03*	*0.000*
Transaction cost (median, Birr/quintal)	*3*	*3*	*0.701*
Share of transaction costs coming from transport (mean, %)	*13*	*13*	*0.000*
Share of transaction costs from use of intermediaries (mean, %)	9	3	0.001
Share of transaction costs from use of telephones (mean, %)	1	7	0.000

Source: Taken from Hill (2008) using EDRI-IFPRI 2008 cereal trader survey, and ILRI-IFPRI 2002 trader survey

[20] Estimates of the price of transporting the 844 km from Djibouti to Addis from January 2007 (one year prior to the EDRI-IFPRI survey results presented above), suggest the per tonne per kilometre cost of transporting along this corridor is $0.06 (WFP 2007).

[21] The gross margin rate (sale price/purchase price) fell, but this was because crop prices were on average higher. Constant transaction costs mask some substantial changes in the costs of transacting (see Hill 2008).

There is evidence of increasing returns to scale among grain and coffee traders in Ethiopia (Gabre-Madhin and Negassa 2005) which contrasts with evidence from other countries in Sub-Saharan Africa. Whilst there is some evidence of economies of scale in some aspects of transacting, overall returns to scale in trading are not observed in Malawi, Benin and Madagascar (Fafchamps, Gabre-Madhin and Minten 2005). The fact that increasing returns were found for larger traders in Ethiopia suggests that some traders are limited in the scale which they operate and their ability to exploit opportunities for spatial or temporal arbitrage.

Analysis of transaction data and information on transportation costs collected in the EDRI-IFPRI 2008 cereal trader survey shows that considering all traders together there is little indication of increasing returns to scale from undertaking larger transactions. It is only possible to look at increasing returns to scale at the transaction level with this survey, as information on two crucial factors of production—labour and trader networks— needed for the aggregate analysis was not collected. One can argue, however, that this is an appropriate level of analysis as it is the level at which the difference between the buying and selling price, the ultimate measure of efficiency, can be compared, and it is also the level at which marketing costs and their impact on this price differential can best be examined (Fafchamps, Gabre-Madhin and Minten 2005). The conceptual framework and estimation method used was that used in Fafchamps, Gabre-Madhin and Minten (2005). Gross margin rates[22] were regressed on characteristics of the sale that may affect the size of the cost, namely the distance travelled, the duration of the sale, and the type of crop being transacted. The gross margin rate was also regressed on quantity, and the significance of the measure of quantity was taken as a test for the presence of increasing returns. This was done for all traders together and by type of trader. When all traders were pooled the marketing functions performed by the trader (assembly, wholesale and/or retail trade) were controlled for through the inclusion of trader type dummies. Given the measurement error present in the data, the log of the gross margin rate was used as the dependent variable and a quantile regression estimation procedure was used. Similarly, for each type of marketing cost incurred the unit cost was regressed on the same variables and the significance of quantity was taken as a test for increasing returns. However, as there is self-selection into whether or not each type of marketing cost is incurred, in these estimations a Heckman estimation procedure was used using trader characteristics (such as gender, number of vehicles owned, working capital and storage capacity) as instruments in the selection equation. In each equation the dependent variable was the log of per unit costs to reduce the impact of outliers on the estimation.

Total per quintal transaction costs and the gross margin rate does not appear to exhibit increasing returns to scale. However, there are a number of trading activities that do show evidence of the presence of high fixed costs, particularly costs associated with search of suppliers, buyers and prices. Personal transportation costs, telephone costs and handling costs all exhibited decreasing unit costs, and thus increasing returns to scale were found among traders—traders whose primary activity was that of purchasing quantities from farmers and aggregating them for sale to wholesalers—who focused on these activities (Table 12). No evidence of increasing returns to scale in transportation was found.

[22] The ratio of the sale price to the purchase price.

Table 12: Testing increasing returns to scale

	Coefficient on quantity*	Test of significance (t-or z-test)	Interpretation
Gross margin rate			
All	*-0.0001*	*-0.16*	*Constant returns to scale*
Collectors	*0.09*	*2.97****	*Increasing returns to scale*
Wholesalers	*-0.002*	*-0.91*	*Constant returns to scale*
Retailers	*0.0004*	*0.34*	*Constant returns to scale*
Cost of transporting per quintal	*0.06*	*0.72*	*Constant unit costs with scale*
Cost of handling per quintal	*-0.06*	*-1.46'*	*Decreasing unit costs with scale*
Cost of personal travel per quintal	-0.75	-6.92***	Decreasing unit costs with scale
Cost of telephone calls per quintal	-0.80	-9.82***	Decreasing unit costs with scale

Source: 2008 Ethiopia cereal trader survey
*The result from a regression which included appropriate controls. The methodology used in Fafchamps et al (2005) was followed.

Looking forward

Cereals currently account for a large share of food consumption in Ethiopia: Seyoum Taffesse (2008) reports that cereals account for 46% of food expenditure and slightly more than a fifth of total per capita expenditure. This is reflected in the dominance of cereals in marketed share of producing households: estimates from the EDRI-IFPRI 2008 household survey show that 54% market some share of cereal production, much higher than the 25% that market pulses and oilseeds, and the 16% of households that market fruit or vegetables. The experience of countries such as China, Vietnam, Indonesia, India and Thailand has shown that income growth (from any source) and urbanization results in reductions in per capita grain consumption and increased consumption of higher value agricultural products such as fruit and vegetables, meat and milk products (Gulati et al 2007, see also Park 2008). Although estimates of consumption expenditure elasticises for Ethiopia vary, and good estimates from new data are needed, the available estimates presented in Table 13 provide some evidence that as incomes rise and the rate of urbanization increases, the share of cereals in expenditure will also decrease in Ethiopia. The elasticities suggest that fruit and vegetables, pulses, beverages, meat, and milk products will become more important. Increasing marketing of these type of products can be expected (and should be supported) as they would be signs of commercialization and transformation of rural agriculture. Park (2008) notes that in China "the most important fundamental trend explaining growth in agriculture has been the steady transformation from a grain-first sector to one producing increased amounts of higher-valued cash crops, horticultural goods and livestock products" with the share of crops in agricultural output falling from 76% in 1980 to 56% in 2000.

Table 13: Expenditure elasticity of domestic demand for different food groups

	Urban elasticities estimates are from Kedir (2005) using 1994 urban household data	**Urban elasticities** estimates are from Wamisho and Yu (2007) using HICES 1999/2000	**Rural elasticities** estimates are from Wamisho and Yu (2007) using HICES 1999/2000
Cereals	0.39	-	-
Teff	0.87	0.73	1.65

Wheat	-	0.19	1.00
Barley	-	0.77	0.68
Maize	-	-	0.61
Sorghum	-	-3.33	0.40
Pulses	0.87	0.40	1.02
Fruit and vegetables	1.05	-	-
Vegetables	-	0.70	0.65
Meat	1.87	1.29	1.89
Coffee	0.76	0.37	0.80
Milk product	-	1.12	0.66
Beverages	-	3.03	3.24

Considerations in achieving the growth potential

Reducing transaction costs will likely require further investments in road infrastructure, transport competitiveness and telecommunications. Although substantial investments have been made in recent years, producers are still located some distance from a road. A 2008 survey of households in Tigray, Amhara, Oromiya and SNNP, the average household was found to live one hour for the nearest all-weather road, and 2.5 hours from the woreda center (EDRI-IFPRI 2008 household survey). In the uplands of Vietnam, households live on average 1km from the nearest road and 4km from the nearest daily market (Minot et al 2006). The costs of transportation, particularly at the first stage of marketing are significant and prevent many households from participating in markets. This is evidenced by the fact that the proportion of households participating in the market for a commodity falls substantially with distance from the nearest market (Table 14). This pattern was only reversed for chat which given its high value has a low transport cost per unit value compared to other crops.

Investments in road infrastructure will only deliver reduced transport costs to the extent they bring about productivity gains in transport activities. Even though, as discussed above, pressure on transport costs between 2002 and 2008 (due to increasing fuel costs) did not increase overall transactions costs, they simply remained high. Increasing competitiveness in the transport sector is clearly required by reducing entry costs: despite liberalization of shipment rates, investments in roads and availability of trucks average freight rates did not change much between 1994 and 2001, suggesting anti-competitiveness in the sector (Gabre-Madhin 2004). This may still be the case and would require closer scrutiny. Finally, improving information flows should also contribute to reducing transactions costs. The establishment of the Ethiopian Commodity Exchange and its market price information boards in regional wholesale markets is an important achievement in this regard. Encouraging other channels by which market information can flow would also help. Mobile phone use remains expensive in Ethiopia compared to neighbouring countries. Increasing availability of mobile phones and reducing the cost of calling would be beneficial. A closer look at the competitive structure of the mobile telephone sector would be in order.

Table 14: Proportion of households selling crops

Proportion of households selling … (%)	**No. of obs.**	**Staples**	**Pulses and oil-seeds**	**Fruit and vegetables**	**Root-crops**	**Chat**	**Coffee**
National average	1679	54	25	16	10	15	11

By distance to nearest market:							
Less than 0.5 hour	423	61	30	16	13	5	11
0.5-1 hour	333	57	30	18	11	17	14
1-1.5 hours	391	52	20	15	10	22	10
More than 1.5 hours	528	48	22	13	7	15	9
T-test that difference between "less than 0.5 hour" and "more than 1.5 hours" is significant		-4.16***	-3.26***	-1.08	-2.41***	2.27***	-3.32***

Source: EDRI-IFPRI 2008 household survey, estimates are weighted to be nationally representative

The evidence above also suggested increasing returns to scale due to fixed costs at least in particular trading activities. Capturing increasing returns to scale in trade could be facilitated by increasing the credit available to small traders that engage in such activities. Alternatively encouraging the development of market intermediaries that can aggregate quantities sold by farmers (such as farmers groups or cooperatives) or that can reduce the costs of search (such as contract farming). On average farmers were found to receive a 7% higher price if they sold through a cooperative as when they sold on their own (Bernard et al 2007) which could in part reflect the benefits to selling on scale. In encouraging the development of cooperatives it is important that they are developed in such a way that ensures they are focused, flexible organizations (which probably requires that they are not too large in size) taking place in the market as market actors rather than developing in such a way that causes them to replace markets. Bernard (2008) discusses these issues in more detail. Specialization or increases in the scale of production would also help farmers to increase the size of their market transactions and reduce per unit transaction costs. In particular, specialization at the village level (when complemented by well-integrated markets) can be one way in which increasing returns to scale in marketing are realised. Increasing specialization in production at the village and regional level has been part of China's agricultural development (Park 2008) and was also a strategy of agricultural development in Japan. Clustering has been observed in the location of handloom sites in Ethiopia, most likely to benefit from geographical economies of scale (Zhang, forthcoming), and the same principles could benefit agricultural production.

In looking at these results and assessing their implications for Ethiopia it is important to bear in mind that they assess the returns to scale given the structure of market institutions as they currently are. For example if all retailers operate on a small scale (as is generally true for grain retailers), it is only possible to determine whether, for the range of sizes observed, there are increasing returns to scale. It is becoming evident from studies in other countries that a move to "modern" market structures—i.e. supermarkets—allows increasing returns to scale to be realized at the wholesale and retail levels. There is currently little sign of this process having started in Ethiopia, but it would be desirable to foster this.

Thus far the government has taken a sequential approach to this market development, i.e. markets for high value agricultural products will develop once cereal production has increased and cereal markets are functioning well. However Table 13 indicates that as urbanization and incomes rise in Ethiopia these sectors will expand much faster than the cereal sector. The following interventions would encourage the development of these: first, contract farming (grower schemes): training farmers, providing intermediation services and inspection services to ensure contracts are upheld;

secondly, allowing and encouraging investment in large scale retail outfits, such as supermarket chains and third, developing the infrastructure for grading and testing fresh fruit and vegetables and simple but effective regulatory systems to set and inspect grades and standards (such as has been established for grains through the Ethiopian Commodity Exchange).

5.3. Factor Markets: Credit and risk

When households with few savings have limited access to credit and high levels of uninsured risk, they under-invest in indivisible assets and in high return but risky production activities. As a result there is less than optimal capital accumulation and specialization in high-return activities, and specialization in low risk, low return crops and activities. In particular, three empirical observations which affect growth have been shown to be present when this is the case: (i) limited application of purchased inputs resulting in a positive relationship between farm-size and yield (Udry 2003); (ii) lower than optimal engagement in high-return activities which require a substantial start-up cost (Barrett and Carter 2006); and (iii) households unable to manage risk engage in farming of low-return, low-risk crops (Dercon 1996), often staple crops to avoid the risk of interacting with the market and causing high levels of autarky even in places with close proximity to markets (Fafchamps 1992).

Additionally, when households have little protection against consumption risk the actions they take to reduce consumption in the time of a shock can have long term effects as child nutrition and development suffers, and spending on education is reduced (Neri et al 2000, Jacoby and Skoufias 1997, Behrman et al 2001). These have both immediate welfare effects and have substantial impact on future earnings potential (Hoddinott and Kinsey 2001) and thus long run growth.

Evidence to date

The evidence for Ethiopia suggests that imperfect credit and insurance markets in the context of high levels of risk and low household wealth, limits investment rates and the extent to which resources are allocated to high-return activities. Poverty rates, although falling, remain high and result in low asset-wealth for many households. High levels of uninsured risk are evidenced by analysis which shows that experiencing drought can lower consumption by about 20% even several years after the event (Dercon, Hoddinott and Woldehanna 2005). Some credit is available, but it is largely seasonal credit for crop input purchases (particularly fertilizer), leaving borrowing for other productive investments and for consumption purposes constrained. The 2006/7 Annual Progress Report of the PASDEP reported that 37% of households are unable to raise 100 Birr within a week for unforeseen contingencies. Households who were able to raise 100 Birr reported financing would come from sales of animals (40%) or crops (14%).Own savings would be used, 9% of the time, borrowing from friends or relatives 18% of the time, and formal loans only 4% of the time (MOFED 2007).

A body of empirical evidence provides evidence of the three predictions outlined in the introduction to this section. First, wealthier households are more likely to purchase fertilizer (World Bank 2006, Annex 15). Whilst constraints on the availability of credit for production and the ability of households to manage consumption risk could give rise to this relationship, it could also arise as a result of other factors. Limited knowledge and education has been correlated with low adoption (Asfaw and Admassie, 2004) and to the extent this is correlated with wealth this may be driving the relationship. Seasonal credit for fertilizer has been widely available (reaching about four million farmers, Spielman, 2009), yet without insurance against the risk of harvest failure this does not ease the credit/insurance constraint poor households face in adopting fertiliser. Households that were more susceptible to the risk of low consumption outcomes (as a result of low levels of wealth and high probability of low rainfall levels) were found to be less likely to apply fertilizer, even when seasonal fertilizer loans were present (Dercon and Christiaensen 2006). A further indication that risk may be a factor in fertilizer adoption is the finding that rainfall variability affects adoption of fertilizer and improved seed (World Bank 2006, Annex 15). Risk has been shown to affect technology adoption in general: farmers who declared themselves as risk averse were found to be less likely to adopt new technology, suggesting that people perceive new technologies as risky to start with (Knight, Weir, and Woldehanna 2003).

Secondly, turning to investments with high start-up costs, there is limited investment in indivisible assets such as irrigation, water pumps, terracing and business assets. Irrigated fields are about 25% more productive than non-irrigated fields. As of 2003/4 only 1.25% of all cropped land applied irrigation, a slight increase from the 1990/1 rate of 1 percent. In terms of households, this is higher, with about 8% of households doing some form of irrigation, including small-scale forms. Irrigable land is estimated to range from 2.3 to 2.5 million hectares which is 22-33 of total cropped area (World Bank 2006). One in four households report deriving some income from non-farm activities, but investment rates in this sector are low (Rijkers et al 2008). The likelihood of investing in non-farm activities falls as rainfall volatility increases and as a household's ability to insure itself falls (proxied by those who can access emergency finance). As a result non-farm activities remain very low-tech as evidenced by the fact that 90% of entrepreneurs walk to market (Rijkers et al 2008). This is in part due to lack of credit for much outside of seasonal credit for fertilizer use, and lack of insurance which makes the indivisible nature of these assets difficult to surmount when the returns are risky. The lack of access to credit and insurance is only one factor contributing to these patterns; investments in land are likely limited by the land-rights institutional set-up, and entry into non-farm activities may also be limited by the preference for remaining a land-owner, and lack of local demand for services. However, Dercon and Krishnan (1996) show that both risk considerations and the need for capital affect entry into different production activities by rural households, in particular the choice between diversifying into low return activities that are characterised by low risk and low entry costs, or higher return activities. Those entering into low return activities were typically located in more remote areas, or had extremely low livestock and other asset levels.

Finally, households that are unable to insure themselves through well-functioning credit and insurance markets are more likely to engage in low variability and low return crops such as enset. To the extent that smaller households are less able to insure themselves one would expect smaller households being more likely to engage in low-return crop production. Using cross-sectional agricultural household data collected by the CSA for the crop years 1997/98 and 2000/01 smaller-scale farmers are found to devote a larger share of their land to enset while larger-scale farmer devote a larger share of land to cereals. The share of land allocated to enset falls from 12% in the lowest decile, to 1% in the highest decile of farm-size, while the share of land devoted to cereals increases from 17% to 25% (World Bank 2006, Annex 14). Smaller-scale farmers were also found to be more diversified perhaps indicating an attempt to reduce the overall variability of crop income, although other explanations (such as fixed costs in engaging in output markets) could explain this.

Looking forward

The World Bank reported that rainfall variability, both droughts and floods, costs the economy over one third of its growth potential (according to simulations studies, World Bank 2006). Reducing production risk through irrigation provides growth potential both through reducing the cost of variability, and through increasing yields. Reforms that encourage the development of credit and insurance markets will result in short term growth arising from efficiency gains in crop choices, and increased investment in fertilizer and indivisible production assets. To the extent that it enables households to take advantage of increasing returns to capital accumulation it will result in sustained growth over the long run. To the extent that it enables entry into activities in which increasing returns to capital accumulation are more likely, it also provides a large opportunity for increased long-run growth.

The growth potential of increased fertilizer use has been discussed previously. Although the discussion in this section has highlighted that improving the functioning of credit and insurance markets is important in ensuring adoption and achieving the growth, commensurate interventions are needed to ensure fertilizer adoption has an impact on growth. These measures would have to be seen in conjunction to the issues of seeds and modern practices as discussed in section 3.1.

Increasing households' ability to deal with risk through improving credit and insurance markets will allow resource allocation to crops with higher average returns. Without a full analysis it is not possible to know how much uninsured risk reduces allocation inefficiency through household's decisions to grow lower risk crops at the expense of lower expected return. However, to provide some illustration, we assume that the 12% allocation of land to enset production among the smallest farming households is largely due to uninsured risk, and that this share could be reduced to 1%, as among the top decile of farmers, by improving the functioning of credit and insurance markets. If this land were allocated to wheat production the agricultural income of the lowest decile of farmers would grow by 4%.[23]

Considerations in achieving the growth potential

Currently the government organizes the provision of credit for fertilizer. The packaging of credit and fertilizer addresses the seasonal liquidity constraints many farmers face and allows more farmers to purchase fertilizer than would otherwise. In the recent past, the use of cooperative leaders, government workers and extension officers to ensure repayment acted as a subsidy on the cost of providing credit. This and the occasional write-offs to bad loans that are provided—in 2001 84 million ETB were written off and in 2005 the Oromia Region was obliged to pay approximately ETB 84 million to the Commercial Bank of Ethiopia to honor its guarantees for the previous 3-year time period (Spielman 2008)— reflected a serious and unsustainable anomaly in credit provision. It also

[23] Taking median 2005-6 prices per kilo for unprocessed kocho (1.28 Birr) and white wheat (2.4 Birr), and average yields of 1.9 tonnes per hectare of kocho (Tsegaye and Struik 2001) and 1.6 tonnes per hectare of white wheat (Seyoum Taffesse 2008).

imposes serious costs and distortions on the functioning of regional administrations. It is suggested that the system is being abolished but it is not clear at present whether alternative financing will take place, or whether any credit for fertilizer will remain available.

Although some form of input credit is needed, provided as such it may be limiting the development of private credit markets in that it is difficult for private actors without these subsidies to compete. The crowding out of the development of private sector credit means that when farmers wish to take credit packages outside of the current system for other crop activities credit markets do not exist. Strengthening rural credit markets may require the government to step out of providing fertilizer in this way. Other mechanisms, such as fertilizer vouchers, may be a means by which fertilizer use can be encouraged without discouraging the development of private input suppliers.

The risk of the government exiting from credit is that rural credit markets may not develop, leaving farmers with no means with which to purchase fertilizer. Some government support of microfinance institutions may be necessary. How to achieve this in a market-conform way is not easily established: credit markets are liable to serious market failure related to asymmetric information and contract enforcement. Governments are unlikely to do better than the market in such circumstances, requiring cautious support for such institutions. Furthermore, agricultural credit is additionally difficult to supply, as agricultural risk is highly covariate, since the most serious risks related to climate, affecting large numbers of farmers at the same time. Repayment would be affected at the same time for many farmers, leaving banks and microcredit institutions seriously exposed. Effort to expand the provision insurance either to farmers or to credit suppliers becomes then crucial.

Ethiopia has collected considerable rainfall data of sufficient quality to allow the development of insurance contracts linked to weather-based indices. The development of a domestic insurance industry for weather risk can be facilitated by encouraging and subsidising experimentation in this area. Uptake can be encouraged by targeting cooperatives or other community groupings, or even input credit suppliers rather than aiming to sell insurance to farmers directly. Countries that have developed comprehensive insurance for farmers against weather risk have done so by subsidising the costs of such insurance (either directly as in the case of the US, or through subsidised reinsurance of local insurance groups as in the case of Mexico). Without subsidisation weather insurance remains quite costly, yet excessive subsidisation on insurance can be equally costly and inefficient (as the case of the US has shown). Experimenting with the appropriate provision of subsidies is thus important.

5.4 Factor Markets: Land and Labour

When land markets function imperfectly and property rights to land are insecure, agricultural households under-invest in land-related investments and engage in sub-optimal renting in and out of land. It is often argued that strengthening a household's property rights through land certification programs will increase incentives for land related investments (by ensuring farmers perceive the returns to any investment undertaken will accrue to them), and reduce the cost of exchanging land in markets for rentals or sales. This has the potential to increase productivity and production efficiency by increasing investment rates and allowing efficient allocation of land across households. Evaluations of land titling programs have provided some evidence on the potential increased incentives to investment that may arise from improved security of tenure. For example in Vietnam it was estimated that the land-titling program undertaken by the government in the 1990s increased investments in tree crops by 7.5%, perennial crops that received a higher return than the annual crops that had previously been grown (Do and Iyer 2008). Indeed, Otsuka (2008) notes that the increased export of coffee from Vietnam was a response to strengthened land rights.

There is an additional means by which strengthening land markets may aid growth. By allowing the rental and sale of property, improved property rights are essential to facilitating migration. By facilitating the release of labour from agricultural production in this way, improving property rights can be an important in increasing the marginal product of labour. Dercon and Zeitlin (2008) highlights the role that improving the marginal product of agricultural labour is likely to play in encouraging growth in Ethiopia. As an example land titling in Vietnam made it more likely that households spent more time in non-farm related activities (11-12 weeks a year on average, Do and Iyer 2008). Additionally, evidence from China suggests that current activities to strengthen property rights may have positive effects on labour mobility, especially to the extent that rental markets are enabled. Such a process also requires vibrant growth in the non-farm rural sector, or strong employment growth in urban areas.

Evidence to date

There is considerable evidence of under-investment in land in Ethiopia, resulting from weak tenure security and property rights. Whilst other explanations may also contribute to explaining these trends, poor property rights may in part explain why only about 5% of irrigable land is irrigated despite improving both agricultural returns (returns are estimated to be higher by 25%) and reduces their variability. It may also contribute to explaining why land terracing is practiced little in areas where it could lead to significant improvements in long term soil quality. Indeed analyses suggest that households that perceive more security over future tenure of land were found more likely to plant trees (Deininger et al 2003, Gebremedhin et al 2003) and build terraces (Deininger et al 2003, Gebremedhin and Swinton 2001). For example if a plot was perceived to have complete transfer rights, the share allocated to coffee was 31% higher, for chat 61% higher and for eucalyptus 50% higher relative to a plot (Gebremedhin et al 2003). Deininger, Ali and Alemu (2008) find that land certification in Amhara made a household 30% more likely to invest in soil and water conservation measures, and doubles the number of hours a household would spend on such activities. Their production estimates suggest that such investments increase productivity by 9 percentage points. There is also some evidence that weak property rights result in inefficient allocation of land across households. Although land-lease markets were not found to be a source of inefficiency in variable input use (Pender and Fafchamps 2001) or productivity (Gavian and Ehui 1999) there is other evidence that points to inefficiencies. Improving land certification in the Amhara region contributed to a 13% increase in the propensity that a household would rent out their land resulting in larger farms renting out land and smaller farms renting in land (Deininger, Ali and Alemu 2008).

More secure land rights may increase the ease with which households transfer labour and resources into the non-agricultural sector through rural-urban migration or through increasing the amount of time rural households spend on non-farm activities. Currently tenure is conditional on farming and continued presence in the kebele. For example, Deininger, Ali and Alemu (2008) report that Tigray recently started redistributing land belonging to those who have been absent from their land for more than 2 years and who earned above a certain level of income. This discourages reallocation of labour and resources from agricultural production to non-agricultural production.

Looking forward

There does seem to be evidence that improving property rights and the functioning of land-lease markets may result in increased investment, adoption of land-related technologies and improved allocative efficiency in land and labour markets. The early evaluations of land certification suggest that it is improving efficiency, in terms of land lease markets, or soil and water investments. Their estimates also suggest that were strengthened land rights extended to all smallholder farmers in Ethiopia, 9% agricultural growth would be realised. To the extent that improved property rights increase allocative efficiency and allow surplus labour to be extracted from the rural sector (see Dercon and Zeitlin 2008) it could be expected that a higher growth impact would result.

From the available evidence, it is hard to assess whether this would remove all inefficiencies related to the specific nature of property rights. Full transferability (outside close relatives) via a sale or other means, nor the use as collateral has not been offered as part of the certification scheme (in line with the constitution), and this is bound to affect growth. The perception is nevertheless that a well-functioning and sustained certification schemes would offer considerable benefits.

Considerations in achieving the growth potential

There is a strong case to build on the certification programmes already implemented by the government of Ethiopia, to ensure that any efficiency gains are sustained. Deininger (2008) discusses a number of important essential steps. First, a system of regular updating of land registries has to be in place. It would be good to ensure that common property areas and house plots are also recorded in land registries. Secondly, at present no graphical description of the land allocated is recorded. Satellite imagery together with GPS coordinates could be used to add a graphical description at low cost. Thirdly, an appropriate system of compensation should be in place in case of expropriation. Finally, a number of specific restrictions are in place on land rental, and they may add further inefficiencies to the system. A careful review of existing restrictions on land rental and relevant modification would be useful.

Increasing tenure security is bound to encourage the investment of smallholders own private capital, however it is important to note at this point that it is possible to achieve substantial land investments by investing public funds. Park (2008) reports that there is currently a debate over the extent to which tenure insecurity in China limits investments in land, yet over half of China's cultivated land is now irrigated as a result of the high public spending on irrigation. More public funds were invested in irrigation than in research, and irrigation spending increased by 17% per year from 1987 to 1996. Current arrangements in Ethiopia leave all land still state-owned, with (long-term) use rights offered to farmers. Nevertheless, public investments will still occasionally require to take land away from farmers, e.g. for road, irrigation or for other purposes such as to offer land for investors with high potentially returns. In this process, it will be crucial to have clear systems and rules of how the state can regain access to land, including defined and fair systems of compensation.

6. Conclusions

In this paper, we focused on the key constraints on rapid yield growth and transformation of Ethiopian agriculture, within the context of an overall growth strategy. To encourage growth in agriculture and in the economy in general, and as a large, landlocked economy with relatively costly access to ports, Ethiopia is required to maintain a delicate balance in which food prices are high enough to ensure incentives for transformation of agriculture, but no so high that they limit long-run growth in the rest of the economy.

Our analysis focused on three key issues. First, what scope is there for rapid yield growth? Secondly, what constraints and opportunities emerge from being a landlocked but open economy? Thirdly, what can be done to improve the functioning of product, input and factor markets? On each of these items much more work is needed to pin down more specific policy responses, but from a systematic review of all the evidence to hand, a number of key lessons emerge.

1. The recent yield expansion recorded in national statistics is of a magnitude that suggests Ethiopia is experiencing one of the fastest green revolutions in history. The magnitude of this growth and the fact it has been achieved with little change in input use suggests something is not right with the data base on agriculture. It is crucial to get clarity on the nature of output growth, the sources of growth in areas cultivated and on whether and how yields managed to improve as quickly as the data suggest, not least as food prices appear to have moved well outside import parity bounds, and therefore well above world prices, in the last year. It is an area of urgent action, as confirmation of the presence and sustainability of the reported high yields is required to ensure that policy actions to increase growth in agriculture remain appropriately well directed. New, targeted data collection, and independent verification and auditing procedures are required to allow the necessary confidence in the current data.

2. The evidence on the scope for rapid yield growth is not as encouraging as it tends to be reported. The combination of improved seeds, fertilizer and improved practices could offer considerable yield increases in some crops, but what is on offer is not comparable in terms of trial field gains to what was on offer during the green revolution. Some of the widely reported evidence, such as the SG2000 trials, is, on closer inspection, not as compelling as it may seem. Evidence from across the world and history suggests that without very high economic returns, in terms of yields and prices for crops, adoption will not take off and spread fast. Even if what is on offer in terms of improved seeds is adopted by all, the gains in output would be (only) 20%, which will be spread over many years. The evidence suggests that the science is lacking: there are not enough high yielding seed varieties available, adapted to local circumstances. Increased international financing of crop research in private and public sectors of excellence is needed (perhaps using models such as those considered by Masters and Delbecq 2008) as is a signal of commitment from the Ethiopia government that improved seeds that are developed will be used. To ensure appropriate adaptation of international innovations to local agroclimatic conditions the domestic research structure requires more financing and scientists, and restructuring that encourages stronger interactions of the international science world, and stronger links with the private sector.

3. A key failure in the efforts to deliver productivity growth is the failure to deliver the combined package of seed, fertilizer and extension to farmers. Much effort has been made on the latter, and fertilizer is typically in ample supply and relatively widely adopted. Improved seeds are only covering less than 5% of land area under cereals cultivation. All evidence points to high returns if the three are combined, at least in key crops such as maize and wheat. While some efforts have been made to increase seed supply, without a massive effort to expand seed multiplication, including via stronger private sector involvement, and reform of the regulatory and support system surrounding it, this will remain a remarkable missed opportunity. Specific recommendations to encourage greater seed production are discussed in Section 5.1.

4. A standard narrative on Ethiopian agriculture is decreasing farm sizes and commensurate negative impacts on productivity. The evidence on whether farms are becoming too small to be efficient is surprisingly conflicting. Some studies have found that there are increasing returns to scale in smallholder agriculture, suggesting efficiency gains from land consolidation. We could not confirm such relationship, rather the standard negative yield-plot size relationship appears to be present in Ethiopia as well. Even if the former evidence is right, simulations on the growth impact from migration (allowing land consolidation) based on the higher estimates available in other studies, showed that the impact was extremely small, undermining the economic significance of this concern. We recognize that this result is puzzling and further work on understanding the costs and potential benefits from land consolidation would be in order.

5. This evidence does not offer insights on whether large scale commercial agriculture could be a profitable source of investment. Currently, large scale commercial agriculture is largely kept separate and does not focus on cereal crops. There is considerable scope for exploring different modalities for stimulating large scale commercial agriculture investments, not just to boost output, including of cereals, but more importantly for their positive externalities on the transformation and commercialization of smallholder agriculture. However, the available evidence also shows that state interventions in these areas typically lead to failure; at best governments can offer a clear and transparent framework to enable investment.

6. For farmers, yield increases are only worthwhile if they translate into higher economic returns. As an open economy with considerable transactions costs to reach international markets, cereals are effectively a non-tradable good for a broad range of prices. Domestic market prices will fluctuate between high import parity prices, when harvests are poor, and low export parity prices, when harvests are highly successful. Low export parity prices are unlikely to offer sufficient incentives. It is therefore essential for agriculture to be faced with growing urban demand, which in turn implies a dependence on growth in the non-agricultural sector. Furthermore, it is imperative for agriculture that transactions costs are actively brought down to narrow the band between export and import parity prices, benefiting farmers and urban consumers. In fact, productivity growth and reducing transactions costs via productivity gains in marketing and transport, have to go hand in hand to be sustainable. Continuing investments in transport infrastructure, particularly investing in transport corridors to the coast, will reduce transport costs. Encouraging competition and investment in transport fleets is also important (discussed further in the next point).

7. Output markets function reasonably well in terms of market integration, but margins between farmgate and consumer prices remain high. While building and maintaining road infrastructure remains important, there is some evidence to suggest that non-competitive markets for transport activities limit the extent to which these investments result in productivity gains in transportation. Increasing competitiveness will require addressing entry costs, including via credit and simpler procedures, but also the apparent presence of non-competitive practices by incumbents requires closer scrutiny. Reducing the cost of mobile phone use, including via encouraging competition could have large benefits. Trade credit, not least towards smaller traders, and exploiting scale economies at the lower levels of the marketing chain should provide other means of exploiting scale economies. Finally, encouraging investments to streamline the marketing chain could have large benefits, given the experience in other countries. Opening up the marketing chain at the wholesale and retail level to supermarkets has shown large productivity increases in marketing and better farmgate prices in many developing countries, not least by rewarding quality improvements and improved commercialization by offering direct outlets for high-value crops. Contract farming arrangements are another example by which commercialization can be fostered.

8. Markets for modern inputs are still functioning relatively poorly. Even though entry is legal, both fertilizer and seed markets are characterized by limited contestability: incumbents (private and public) appear to have considerable advantages including on credit, making entry or expansion of other players difficult, both at the wholesale and retail level. As fertilizer prices remain a serious constraint on profitable adoption of modern inputs, productivity increases in the handling and marketing of fertilizer remains an important factor to increase incentives to farmers.

9. Insurance markets remain underdeveloped, while formal or microfinance rural credit markets are dwarfed by the input loan system. The latter is increasingly dysfunctional, not least given its links to the regional state public finances, and its disappearance appears now likely. Nevertheless, across the world, working capital credit, such as credit for inputs, has always been a key part of rural transformation, and the vacuum left by the likely disappearance of the current input loan scheme is both a danger, but also opportunity to foster better models of rural credit delivery, possibly linked to insurance. Insurance markets are underdeveloped, while agriculture in Ethiopia is among the most risky in the world. Furthermore, adoption of new techniques and inputs carry considerable risks for farmers. While crop insurance for smallholder agriculture is unlikely a sustainable option, it is imperative to develop schemes that offer protection and insurance when harvests fail, beyond safety nets. Pilots that creatively take forward ideas on index-based insurance and other models that involve limited transactions costs should be actively encouraged, and become part of an improved overall infrastructure for rural credit provision.

10. Finally, much progress has been made on improving security of land tenure in Ethiopia, even though the schemes still fall well short of full transferable and collateralisable land rights. Nevertheless, land certification appears to have brought benefits, and it will benefit farmers if it is consolidated everywhere. It will be imperative to develop and continuously update land registry systems and the opportunities of modern technology for area measurement and recording could offer further security. At the same time, commercialization efforts in agriculture will require mechanisms to get access to rural land for investment. These mechanisms should be clear and transparent, with reasonably fast, legally enforceable and contestable procedures.

Appendix Results from On-Farm Trials on Maize in Ethiopia

Ethiopian agricultural researchers have conducted a number of farm-level trials under controlled circumstances on the impact of using improved or hybrid seeds, as well as on the impact of improved practices and techniques. Appendix table 1 summarizes the key findings from a systematic review from on-farm demonstration trials taken from Chimdo Anchala, Aberra Deressa, Shemelis Dejene, Fekadu Beyene, Nigusse Efa, Belete Gebru, Akalu Teshome and Maikal Tesfaye (2001), "Research center based maize technology transfer: efforts and achievements", in the proceeding from the Second National Maize Workshop of Ethiopia, 12-16 November 2001. Data reported here are from Awassa, Jimma, Bako, Pawe, Adet and Melkassa, mainly from trials in the 1990s. Some evidence we have seen from more recent years does not seem to be offering gains in yield of a different order of magnitude. Obviously, yields will differ not just by variety but also by year and location, due to temporary and permanent differences in agro-ecological and climatic circumstances. The data involved a variety experiments, involving combinations of using improved or hybrid seeds and using improved practices. The latter involve using fertilizer as well as optimal timing and techniques of activities such sowing, weeding and harvesting. Given that these are typically data from properly controlled trials, the data allow us to summarize findings in a variety of dimensions, expressed at the percentage yield increment based on:

-comparing the impact of using improved seeds over local seeds when both use improved practices (column (8));
-comparing the impact of using improved seeds over local seeds when both use local practices (column (9));
-comparing the impact of using improved practices over local practices when both use local seeds (column (10));
-comparing the impact of using improved practices over local practices when both use improved seeds (column (11));
-comparing the impact of using improved practices plus improved seeds and using local practices and local seeds (column (12)).

Two tables are offered. Table 1 gives the raw data. Table 2 gives the key findings of table 1. They can be summarized as follows. While there is much variability in the trial evidence (suggesting that small changes in circumstances can have big impacts), there are unsurprisingly considerable impacts from these experiments. The yield gains from improved or hybrid seeds are about 50% when improved practices are used. These gains are only about 20 when using local practices continue to be used. This has two implications: the marginal return to seeds are higher when other parts of the 'package' is present, including optimal fertilizer use and improved practices. Column (10) and (11) show this: using improved seeds, the marginal gain from using improved practices is very high. The overall impact of getting seeds and practices right, compared to traditional practices and seeds are found to be about 134 percent on average – considerable, but they do involve a lot.

This evidence is from farm-level trials (and not trials on research stations), although often in areas typically near to the stations. Local adaption requirements for seeds would mean that it would be unlikely that the higher yields would be obtained in a very large area. Furthermore, improved practices are also likely to have to be differently defined in different areas, so that a road to obtaining such higher yields will be relatively slow. For other crops, no evidence was found at a comparable scale, suggesting serious limitations to the maximum yield gains for cereals as a whole that can be expected within reach given the currently known improved seeds and techniques.

Appendix table 2: Summary of Appendix table 1.

	(8) % yield increment of improved seed over local seed (when both used improved practice)	(9) % yield increment of improved seed over local seed (when both used local practice)	(10) % yield increment of improved practices over local practices (when both use local seeds)	(11) % yield increment of improved practices over local practices (when both use improved seeds)	(12) % yield increment of using both improved seeds and improved practices over using local seeds and local practices
Total average	49%	20%	54%	69%	134%
Comparable sites average	51%	20%	54%	80%	132%
Hybrid only average	52%	26%	59%	70%	141%

Appendix Table 1 Results from key trials on maize (on-farm demonstration plots).

(1) Location	(2) Year	(3) No. of demonstrations	(4) Variety	(5) Mean grain yield (quintals per hecatre) using improved practices	(6) Mean grain yield (quintals per hecatre) using local practice	(7) % yield increment from changing practice	(8) % yield increment of improved seed over local seed (when both used improved practice)	(9) % yield increment of improved seed over local seed (when both used local practice)	(10) % yield increment of improved practices over local practices (when both use local seeds)	(11) % yield increment of improved practices over local practices (when both use improved seeds)	(12) % yield increment of using both improved seeds and improved practices over using local seeds and local practices
Awasa	1991/92	6	A-511	38.5	18	113	67	29		113	175
			Local	23	14	64			64		
	1992/93	8	Beletech	40	21	90	48	31		90	150
			BH-140	37	19	95	37	19		95	131
			BH-660	42	23	83	56	44		83	163
			Local	27	16	69			69		
	1993/94	10	Beletech	44.5	21	111	46	8		111	128
			BH-1440	40	23.7	74	32	22		74	105
			BH-660	55	29	74	81	49		74	182
			Local	30.4	19.5	56			56		
	1994/95	27	BH-140	58	29.04	100	82	55		100	209
			Beletech	35.62	20.4	74	12	9		74	90
			Local	31.85	18.76	68			68		
	1995/96	26	BH-140	53.6			71				164
			BH-660	56.7			81				179
			BH-540	50.5			61				149
			Local	31.3	20.3	54			54		
	1996/97	22	BH-140	50.9			54				147
			BH-660	63.2			92				207
			BH-540	49.5			50				140
			Local	33	20.6	60			60		
	1997/98	26	BH-140	59.8			69				152
			BH-660	66.6			88				181
			Local	35.4	23.7	49			49		
	1998/99	26	BH-140 BH-660	50.2			43				80
			BH-660	58.1			65				108
			Local	35.2	27.9	26			26		
(1)		**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**

Location	(2) Year	No. of demonstrations	Variety	Mean grain yield (quintals per hecatre) using improved practices	Mean grain yield (quintals per hecatre) using local practice	% yield increment from changing practice	% yield increment of improved seed over local seed (when both used improved practice)	% yield increment of improved seed over local seed (when both used local practice)	% yield increment of improved practices over local practices (when both use local seeds)	% yield increment of improved practices over local practices (when both use improved seeds)	% yield increment of using both improved seeds and improved practices over using local seeds and local practices
Jimma	1991/92 1992/93	4	UCB	43.7	24.5	78	11	-15		78	52
		10	UCB	38.2	27.05	41	-3	-6		41	33
		6	Beletech	33	27.2	21	-16	-6		21	15
		6	Local	39.4	28.8	37			37		
	1993/94	2	UCB Beletch	40	27.05	48				48	
		2	Beletech	33	27.2	21				21	
		2	BH-140	34.1	27.2	25				25	
	1994/95	10	UCB	46.57	25.75	81				81	
		10	Beletech	39.6	25.7	54				54	
		10	BH-140	34.1	25.75	32				32	
		10	BH-660	51.53	25.75	100				100	
	1995/96	6	UCB	50.53	25.75	96				96	
		6	Beletech	48.8	25.7	89				89	
		6	BH-140	47.84	25.75	86				86	
		6	BH-660	65.32	25.75	54				54	
	1996/97	8	UCB	58	25.75	125				125	
		8	BH-140	44.5	25.7	73				73	
		8	BH-660	69.1	25.75	168				168	
		8	Kuleni	58.7	25.75	128				128	
	1997/98	7	UCB	49.4	25.75	92				92	
		7	BH-540	45.5	25.7	77				77	
		7	BH-660	56.8	25.75	120				120	
		7	Kuleni	54.7	25.75	112				112	
Adet	1998/99	3	BH-540	43.15	29.95	44				44	
		3	Kuleni	47.4	28.44	67				67	
	1999/2000	2	BH-540	69.7	42.99	62				62	
		3	Kuleni	50.4	30	67				67	
		2	BH-660	93.85	58.39	60				60	

(1) Location	(2) Year	(3) No. of demonstrations	(4) Variety	(5) Mean grain yield (quintals per hecatre) using improved practices	(6) Mean grain yield (quintals per hecatre) using local practice	(7) % yield increment from changing practice	(8) % yield increment of improved seed over local seed (when both used improved practice)	(9) % yield increment of improved seed over local seed (when both used local practice)	(10) % yield increment of improved practices over local practices (when both use local seeds)	(11) % yield increment of improved practices over local practices (when both use improved seeds)	(12) % yield increment of using both improved seeds and improved practices over using local seeds and local practices
Pawe	1999/2000	4	BH-530	81.7	41.7	95				95	
		4	BH-140	76.7	41.7	84				84	
Bako	1992/93	9	BH-140	34.2	29	18	18			18	
		9	Beletech	38.2	29	32	31.7			32	
		9	Local	29							
	1993/94	4	BH-140	47.9	36	33				33	
			Beletech	36.5	36	1				1	
			BH-660	52.1	36	45				45	
	1994/95	4	Beletech	26.74	24.6	8				8	
		4	BH-660	40.02	24.66	62				62	
	1995/96	6	Beletech	47.07	36.5	29				29	
		10	BH-660	62.09	36.5	70				70	
		10	Kuleni	41.08	36.5	25				25	
Melkassa	1991	11	Katumani	16	12	33				33	
	1992	10	Katumani	21	10	110				110	
	1993	8	Katumani	18	12	50				50	
	1995	4	Katumani	16	7	128				128	
	1998	12	Katumani	10	7	38				38	
	1998	12	ACV3	10	7	40				40	
	1998	12	ACV6	11	7	40				40	
					Total average		49	20	54	69	134
					Comparable sites average		51	20	54	80	132
					Hybrid only average		52	26	59	70	141

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