Future Agricultures

Research Paper

# Getting Agricultural Moving: Role of the State in Increasing Staple Food Crop Productivity with Special Reference to Coordination, Input Subsidies, Credit and Price Stabilisation

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## Executive Summary

This paper argues that the state has a large potential role in increasing staple food crop productivity as a result of

- The importance of staple food crop intensification in driving and supporting pro-poor growth in poor rural areas and
- Intrinsic difficulties that inhibit staple food crop intensification without significant investment and coordination by the state.

Active state involvement was a pervasive feature of Asian green revolutions, but the task is not easy, particularly with the varied and often difficult agro-ecological conditions in Africa, the lack of irrigation infrastructure, likely impacts of climate change, the limited human and financial resources available to governments, and the political challenges facing governments in pursuing consistent policies.

Increasing staple food crop productivity requires governments, with private sector actors, farmers and civil society, to address a number of challenges. These are posed by specific technical constraints to productivity increases; lack of important public goods (principally infrastructure and institutions); recent dramatic increases in food and fertiliser prices; poor policy coordination; lack of complementary coordination in rural service development and provision; the food price/ productivity tightrope; unaffordability of on-farm productivity investments; and high price instability.

The nature of and solutions to these challenges, and hence the nature and importance of responses to them, vary between three different types of crop – characterised as high response cereals (maize and rice), low response cereals (sorghum and millet), and roots and tubers (cassava and yams).

The first two challenges in this list are reviewed briefly, as they are beyond the scope of this paper. More attention is given to setting out the severity and implications of recent commodity price increases on staple food production. However most attention is given to setting out the coordination problems faced in staple food crop intensification and then, in this context, to implementation challenges and possible AGRA actions with regard to input subsidies, credit and price stabilisation.

With regard to coordination, AGRA is encouraged to support regional or national processes promoting coordination among supply chain actors and learning across supply chains and countries.

Input subsidies have considerable potential to contribute to food security, poverty reduction and economic growth, and are an important entry point where markets are thin and support services to producers (e.g. extension) are weak. However, their benefits depend upon an effective basic input technology, good programme design and implementation, and indirect subsidy impacts on staple prices, the rural economy and wages. A number of recommendations are made for AGRA to help further knowledge of good practice and help countries design and implement effective programmes.

Seasonal credit programmes represent one possible exit strategy from (more expensive) fertiliser subsidies. However, they only tackle the affordability constraint to fertiliser adoption, so fertiliser use has to be profitable at current prices if credit is to encourage adoption. Current fertiliser prices on world markets mean that this will not be the case at least for the forthcoming season in Africa. The paper proposes the creation of competitive challenge funds to encourage financial organisations to innovate in providing seasonal finance to smallholder producers and explains why a modest subsidy element is necessary to accomplish this.

Finally, efforts to encourage intensification of staple crop production are likely to founder

if producer prices collapse under the influence of increased production. At the other end of the scale, poor consumers must be protected against the negative impacts of high food prices. Food price instability is identified as a particular problem in southern and eastern Africa. The paper considers what needs to be done in order to promote greater intra-regional trade in staple foods, which should reduce the extremes of price instability. Weather-indexed insurance schemes and the establishment of regional grain storage facilities are proposed as part of a broader strategy.

## 1. Introduction

This paper addresses the following questions:

- What role should the state play in promoting staple food crop intensification?
- How can AGRA promote improved state roles in terms of pilot initiatives, advocacy and research?

The paper begins by briefly reviewing the historical and theoretical importance and roles of the state in staple crop intensification, drawing from both Asian and African experience. A core message from this is the need in particular crops for some coordination role to be played by the state in service provision, and we therefore examine the specific coordination problems facing intensification for the different major staple crops in Africa with different intensification processes. This provides background for the main parts of the paper which examine in more detail the particular challenges in increasing input use, in credit provision, in food price stabilisation and in coordination in staple food crop intensification and, with these challenges, roles for the state and actions that AGRA might take to promote more effective state action to fulfil these roles. The paper pays particular attention to potential and (as compared with recent orthodoxy) less conventional roles of the state in providing input subsidies, coordination, credit and price stabilisation.

## 2. The importance of increasing staple food crop productivity

The importance of increases in staple food crop productivity as a foundation for broad based economic growth is stressed by well established theories of development with strong empirical evidence. Recent increases in global food prices have brought this home to policy makers in both the international community and national governments.

Agriculture can play two potential roles in wider economic growth, driving growth (providing fundamental increases in productivity and earnings) and/or supporting growth processes in terms of multiplying and spreading the benefits of primary growth drivers through an economy (Poulton and Dorward 2003). This is illustrated in figure 1, which shows how agriculture can work as a growth driver in two ways. First, growth in production of tradables (imported or exported commodities) raises incomes of domestic producers who can produce either below import parity price for domestically consumed products or below export parity price for exports. In either case, production and producer incomes can expand without affecting prices (as these are determined in world markets). Another way in which agriculture can drive growth is through increased production of non-tradable or semi-tradable products which are important in people's expenditure (with high average budget shares). Here growth occurs through increases in consumer incomes as a result of reduced prices and hence reduced expenditure, releasing funds for other expenditures.

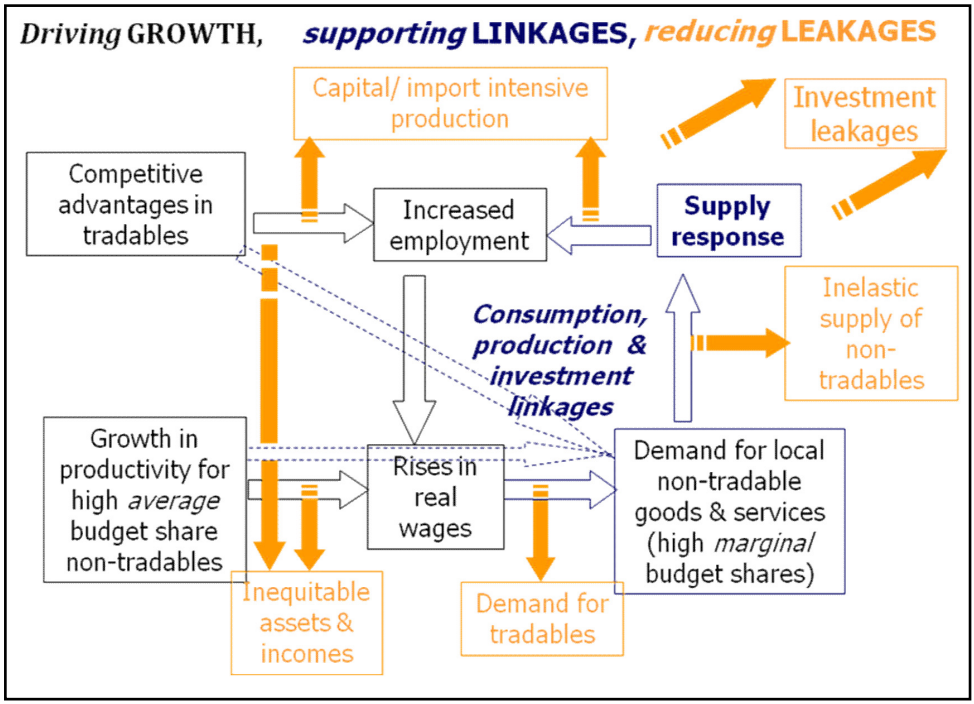
Agriculture has an important role as a growth supporter because if people's incomes are rising (as a result of agricultural or non-agricultural

growth drivers) this will lead to increased expenditure on horticultural and livestock produce (as demand for these products trends to rise with increasing income). If local agricultural producers are able to respond to this increased demand then this multiplies and spreads the benefits of the original growth stimulus. If local agricultural producers are not able to respond to this increased demand then the extra demand will lead to imports (leaking out of and being lost from the economy) and/ or inflation (reducing the increases in real income from growth drivers).

Increases in staple food productivity can drive growth as a tradable in countries where staple food consumption is well integrated with world markets. Such countries tend to be coastal and to rely on cereals (wheat, maize or rice) as major staple foods. Where staple food consumption is less well integrated with world markets (as is the case with cereal crops in land locked countries and with root crops even in coastal countries) then increases in staple food productivity can drive growth as a non-tradeable. Even as a tradeable in a coastal country, a shift from importing to self sufficiency or exporting of cereals may lead to some domestic price reductions, through differences between import and export parity prices due to shipping and port costs. Increases in staple food productivity also have two potential roles as growth supporters, first in releasing resources for other productive

**Figure 1. Drivers, supporters and leakages in a local economy**

Source: Dorward et al. 2003)

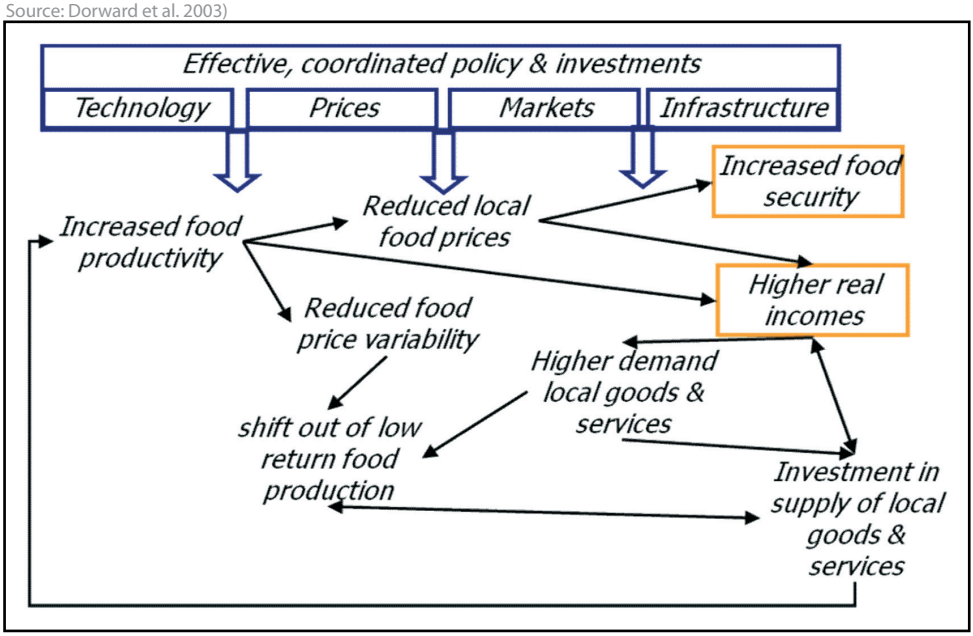


resources where there is rising demand for non-staple and non-farm goods and services, and second in providing feedstock to meet rising domestic demand for livestock products. In both these cases increases in staple food productivity reduce leakages through increased domestic linkages where staples are tradeables and through increased elasticity of supply where staples are tradeables. The importance of all these roles of increased food staple productivity has been brought home by the current high global food and fertiliser prices – which will be discussed in more detail later.

These potential roles of increases in staple food crop productivity in driving and supporting growth are potentially particularly important and effective in poor rural economies because of the large absolute and proportionate scale of resources poor people and poor economies devote to food production and consumption and the large numbers of (particularly poor) people and large amounts of land and capital involved in their production. 'Deficit food producers' (farmers who produce less food than they consume and are therefore both producers and buyers of food crops) are generally considered to constitute roughly 50% or more of farmers in much of Africa and to be poorer than surplus food producers (see for example Barrett in press). Such people can get a double benefit from staple food crop productivity increases, as both producers and consumers. Growth linkages from income gains from poor people also tend to be high due to consumption patterns with a high non-tradeable content (Hazell and Hojjati 1995; Delgado et al. 1998). Finally, there are further benefits where increases in staple food crop productivity lead to low and stable

**Figure 2. Potential impacts of increased staple food crop productivity**

Source: Dorward et al. 2003)



food prices as well as increased real incomes for large numbers of producers and/or consumers. This can (a) stimulate demand for non-staple and non-farm products (as a result of higher real incomes), (b) provide resources for investment in supply to meet this demand (also as a result of higher real incomes) and (c) allow people to shift out of low return food production (which they may be locked into as a result of the need for subsistence production in the context of high and variable food prices) and into higher return non-staple and non-farm activities. These benefits from staple food crop productivity increases are illustrated in figure 2.

Finally we note that increases in staple food crop productivity can also have environmental benefits if these reduce pressures for cultivation on marginal or forested lands, and/or involve improved soil management (with reduced run-off, and soil erosion).

## 3. Challenges in increasing staple food crop productivity in Africa

Having identified in the previous section different ways in which increasing staple food productivity can be important for poverty reduction, food security and growth in poor rural economies, we now move on to consider in this section the broad processes by which such increases can be achieved and the major challenges to these processes. We compare the (largely Asian) green revolution experience with challenges and opportunities facing increased staple crop productivity in different parts of Africa today. This provides an important foundation for subsequent discussion (in later sections of the paper) of more detailed and practical actions needed to achieve increased staple food productivity in Africa, identifying different opportunities and challenges for different crops in different situations.

The Asian green revolution is widely cited as a major success story in driving dramatic, widespread and sustained increases in staple food productivity that have provided the foundation for subsequent dramatic increases in economic growth, poverty reduction and food security in many Asian countries, and across the world. It involved intensification of production of mainly wheat and rice, through new technologies involving mainly seed for new crop varieties with a high yield response to fertiliser use under irrigated conditions. Although attention in the past has been largely focussed on the technical research and innovation that underpinned the green revolution, there is increasing recognition of the importance of major institutional and price interventions that were necessary to allow the rapid uptake of the new technology. Dorward et al. 2004 found in a review of successful and partially successful green revolution areas widespread government interventions to fix and stabilise output prices and to subsidise input supply and credit'. They argue that there are certain necessary conditions for intensive cereal based transformations and that in addition to high yielding technologies there need to be effective input, output and financial exchange systems offering producers stable and reasonable returns to investment in 'improved' technologies, together with reasonably secure and equitable access to land. Successful green revolutions therefore involved critical government intervention in 'kick starting' markets. They also observed that these interventions tended to become inefficient and ineffective over time, their success led to large fiscal costs, and they then became a burden rather than a stimulus to further growth. This analysis explains successes and failures with both more liberalised and more interventionist approaches to increasing staple food crop productivity. It is argued that state interventionist approaches

will not be effective, or will be less effective, if (a) they are implemented before basic conditions have been established, (b) they are implemented badly (and their effective implementation is very costly and challenging, as discussed later), (c) they are not implemented long enough to achieve sustained structural changes in productivity and markets, and/or (d) they are continued for too long after they have achieved sustained structural changes in productivity and markets. Liberalised market approaches, on the other hand, will not be effective if they are relied upon before the establishment of basic conditions or before basic productivity and market development has been achieved.

How does this experience relate to conditions and challenges in Africa today?

The low productivity and low intensity of input use in African staple food systems are well known. Although there are significant questions about the reliability of production and input statistics, FAOStat data on the changes in food productivity shown in table 1 below and in Annex Figures A1 and A2 are generally accepted to be consistent with broader patterns of economic growth, food security and poverty incidence. These show steadily increasing food production in different African regions over the last 20 years or so, but a much more mixed picture food production per capita. While North Africa and West Africa have seen fairly steady growth from 1997 to 2006 there is a more mixed picture from other regions in the continent – per capita production in 'middle Africa' has declined while Eastern and Southern Africa show very weak (not significant trends), and particularly high variability in Southern Africa.

Yield figures are also very low, with cereal yields static in recent years at below 1 tonne per ha (as compared with steadily increasing yields of more than 2 tonnes per ha in Asia and Latin America) (Morris et al. 2007).

These figures raise questions about the nature of processes and sustainability of increasing food production in different parts of Africa, to which we will return later. They also show a marked contrast with other continents where food production per capita has shown much stronger and more sustained growth.

The most recent FAOStat figures on country fertiliser use do not appear to be reliable. However rates of fertiliser use in Africa (excluding South Africa) have been and continue to be very low. Morris et al. 2007 present FAOStat figures up to 2002 showing fertiliser use intensity of total nutrients in SSA at less than 10kg/ ha (compared with 80kg/ha or more in Asia and Latin America) and growing at less than 1% per

**Table 1. Africa food production: Linear growth rates**

| | Total | | Per capita | | |
|---|---|---|---|---|---|
| | 1990-2006 | 1997-2006 | 1990-2006 | 1997-2006 | |
| Africa | 2.9% | 3.2% | 0.7% | 0.7% | *** |
| Eastern | 2.3% | 2.9% | -0.2% | 0.2% | ns |
| Middle | 1.5% | 2.1% | -1.3% | -0.6% | ** |
| Northern | 3.3% | 3.5% | 1.7% | 1.6% | *** |
| Southern | 1.6% | 1.8% | -0.1% | 0.5% | ns |
| Western | 3.7% | 3.8% | 1.2% | 0.9% | ** |

Source: FAOStat Production Indices, June 2008 ; ***, P=0.001 ; ** P=0.01 ; ns P>0.05.

year (compared with 3% or more in Asia and Latin America). Crawford et al. 2006 show that in the period up to 1996-2002 only one Sub Saharan country (apart from South Africa) had both average fertiliser use rates of more than 25kg/ha and growth of more than 30% per annum: Kenya. These fertiliser rates are for large commercial and small holder farms, and for cash and staple crops – with fertiliser use likely to be heavily skewed towards large commercial farms and cash crops – with much lower rates of use on smallholder food crops, though the greater area under food crops means that a large proportion of fertiliser use in Africa is probably on staple foods (Kelly 2006, cited by Morris et al. 2007). Differences in growth in fertiliser use do not appear to be associated with differences in agricultural growth rates between West Africa and other parts of Africa.

### 3.1. Causes of low growth in African food staples production

A variety of broad explanations are put forward as contributing to the mixed and generally disappointing situation as regards food crop productivity in Africa, demanding a variety of policy responses. In these lack of productivity growth may be explained by

- government failures to fully liberalise their agricultural sectors (e.g. Kherallah et al. 2000; Jayne et al. 2002)
- weak institutional support for market and private sector development, with cultural, political and legal factors undermining clear contract enforcement and property rights and hence private investment incentives (e.g. World Bank 2000, 2002, 2003).
- lack of long term productive investments in agricultural research and extension and in rural infrastructure – due to declining overall investments in agriculture and crowding out of long term productive investments by fertiliser subsidies and price supports which yield little long term benefits (e.g. Maxwell and Heber-Percy 2001; Jayne et al. 2002; Africa Commission 2005).
- coordination failures in liberalised markets (Dorward et al. 2005; Poulton et al. 2005).
- the weakness of the state in many African countries, with a lack of strong institutions protecting private investments and of capacity to implement policy, with misuse of power and resources (for example Lockwood 2005)
- high service delivery costs to smallholder farmers limit the supply of and access to input, finance, and produce markets and to technical and management information (for examplePeacock et al. 2004; Poulton et al. 2005).
- declining soil fertility and incomes locking smallholder farmers into a spiral of increasing poverty and an inability to afford purchased inputs needed to increase productivity (UN Millennium Project 2005a, b).
- national and international demand and trade constraints which limit the returns and potential returns to agricultural investment in Africa (for example Diao et al. 2003).
- inherent limited productive potential of rain fed agriculture which is unable to support an increasing rural population (for example Ashley and Maxwell 2001; Ellis 2005).

Many of these explanations and the policy responses that they call for are complementary. Principle divergences arise over the potential for agriculture to drive growth, the role of the state, and the optimal balance between different investments and priorities in different contexts. It is important therefore to identify the staple crops and agro-ecological conditions where there is the most potential for increasing staple food crop productivity with the greatest poverty reduction, food security and growth benefits.

### 3.2. A typology of food staples intensification opportunities and challenges

Drawing on insights from Byerlee et al. 2006 and Hazell et al. 2007, table 2 presents a typology that sets out first the major roles for increased staple food crop productivity for different types of crops in countries with different characteristics, and then the major challenges that need to be addressed to achieve increased productivity. We distinguish first between three different types of crops (and implicitly between different agro-ecological zones associated with these crops). Maize, rice (notably NERICA) and possibly wheat (though this is a much less important crop in Africa) are cereals with potential high responses to significant investments in inorganic (and organic) fertiliser application. Millet and sorghum have generally lower yield potential, but there are still possibilities for significant yield responses in the context of integrated soil fertility management (ISFM) practices involving, for example, better water control, use of organic matter and micro-dosing with critical nutrients[1]. Root crops, particularly cassava, have the potential for significant yield increases with intensification but although with time this will require substantial increases in fertiliser inputs, there are initial opportunities for major yield increases from improved varieties. A TSBF report identifies 32 million ha of maize warranting ISFM investment in moist savannah and woodland zones, with 23 million ha of sorghum and millet in Sahelian drylands, and 18 million ha of cassava and 2 million ha of NERICA in the humid forest zone. There is also likely to be potential for ISFM investment in further areas of cassava and NERICA in the moist savannah and woodland zones (TSBF 2007).

**Table 2. Typology of Staple Crops by Roles, Countries and Challenges**

| | High response cereals maize, rice, wheat | Low response cereals sorghum, millet | Roots/ tubers cassava, sweet potatoes |
|---|---|---|---|
| Broad Role | Pro-poor growth | Least cost welfare, growth platform | Pro-poor growth |
| Countries with Minerals | Support & spread growth | Subsistence, support & spread growth | Support & spread growth |
| Coastal, Nominerals | Regional driver & supports growth | Subsistence & support growth | Regional driver & supports growth |
| Land locked Nominerals | Major driver & then supporter | Subsistence | Major driver & then supporter |
| Challenges | Irrigation? | Yield package? | Processing? |
| | ← - - - - - - - - Public goods - - - - - - - → (research, infrastructure, institutional environment) | | |
| | ← - - - - - - Global commodity prices - - - - → | | |
| | Policy coordination - - - - - - → | | |
| | Complementary service coordination - - → | | |
| | Price / productivity tightrope - - - → | | |
| | Affordability - - - - - - - → | | |
| | Price instability (intra& inter seasonal) | | |

The high potential yields achievable with the 'high response cereals' and 'roots and tubers' suggests that these have the potential to make a major contribution to driving and supporting pro-poor growth in countries where these crops can be produced, depending on other potential drivers of growth in these countries. Following Collier 2007 we distinguish between countries with and without significant minerals and for countries without minerals between coastal and land locked countries. Where a country has significant earnings from minerals then these may be expected to drive growth, but, with careful management of mineral earnings and of the macro economy, increased productivity of high response cereals and roots and tubers has a major role in supporting such growth (increasing linkages and reducing leakages) and in spreading the benefits of mineral earnings within the population. In coastal countries without minerals there should be potential for the development of export manufacturing industries, and if high response cereals and roots and tubers can be grown then increasing their productivity (and cash crop production) should be a driver of growth alongside these industries, as well as supporting growth. Where landlocked countries have no significant minerals then increasing productivity of high response cereals and/or of roots and tubers are likely to be, with cash crops, the major growth drivers. However, as {Collier, 2007 #63} observes, none of the options for countries in this category are likely to deliver high aggregate growth rates for the foreseeable future.

The lower but still improved yields achievable with 'low response cereals' in more challenging agro-ecological conditions suggest that these will not be able to drive growth but they should have important roles in supporting growth and in providing a low cost subsistence safety net. Again the role will vary between countries with opportunities for minerals, manufacturing industries and cash crops to drive growth (although the more challenging agro-ecologies where these crops are grown are also likely to limit cash crop and livestock development options). However investment in increased staple productivity may be a least cost way of providing safety nets in a way that encourages economic activity rather than dependency.

What then are the major challenges to increased productivity of these different staple crops? We conclude this section by noting from table 2 three fundamental issues that are critical for the profitability and affordability of farmer investments in increasing staple productivity but are outside the scope of this paper: technical challenges affecting input requirements and yield increases and stability; public goods provision affecting the same variables, prices and business risks; and global commodity prices. In subsequent sections we will then consider in more detail the nature of and possible responses to four challenges that are the focus of this paper: coordination challenges; the food price/profitability tightrope and input subsidies; affordability and credit; and price instability.

### 3.3. Technical challenges

A major difference between the historical Asian and proposed African green revolutions is the predominant focus of the Asian green revolutions on irrigated cereals with high yield potential. There have been some successes on rainfed crops (Smith and Urey 2002), but these have been in the context of a prior green revolution on irrigated crops. There has been little success with low response rainfed crops or with staple root crops. Thailand has become a major cassava producer and exporter, but this is not normally considered as part of the Asian green revolution, cassava is produced as a cash crop and its production originally expanded as a processed export crop in the context of an economy that had already benefited from a cereal based green revolution and low rice prices.

Increasing staple food crop production in Africa therefore faces serious technical challenges with regard to limited irrigation and uneven irrigation potential for high response crops, and the development of higher yield technologies for low response crops. These challenges are likely to be exacerbated by increasingly variable rainfall expected in many areas as a result of global climate change. Solutions will include the development of more drought resistant high yielding varieties, better soil and water management, and investment in irrigation. Many of these are being addressed or are likely to be addressed under AGRA's "Programme for Africa's Seed Systems" (PASS), Soil Health Programme (AGRA, 2007), and water programme.

The immediate technical challenge for cassava relates to reducing labour requirements for harvesting and processing through the development of new harvesting and processing technologies and/or of high yielding varieties with suitable harvesting and processing characteristics. (Nweke 2004.

### 3.4. Public good challenges

As noted earlier, it is widely agreed that poor and limited transport infrastructure, under funded agricultural research and extension, weak institutions (in terms of formal and informal legal frameworks conducive to private sector investment in productive activities) and 'state failure' have been a significant constraint to agricultural development, and particularly staple crop development, in many parts of Africa. Although international donors, private foundations and NGOs can invest in some public goods (for example research and extension), the impact and sustainability of such investments generally depends upon wider supporting state systems. Some public goods are almost completely dependent upon a strong, competent and accountable state, and although civil society and external agencies can in some ways encourage good governance, there are many aspects of governance which ultimately depend upon longer term development of political systems.

### 3.5. Global commodity prices

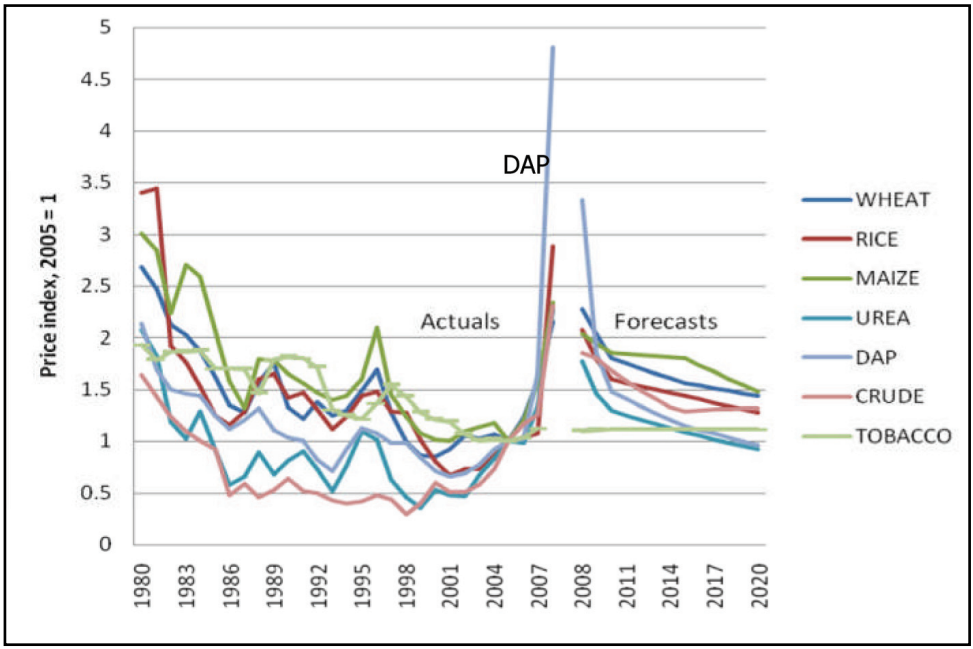
From early 2007 international commodity markets have been affected by a series of price rises that have been particularly severe in their effects on energy, grain and fertilizer prices. Prices of different grains and fertilizers have followed different patterns, and while there is general agreement about the list of short and long term causes of many of these price increases, there is no clear agreement of understanding regarding the relative importance of some of these causes, and when and how far prices are likely to fall back.

Figure 3 shows how commodity prices have changed over the last 30 years or so, and World Bank forecasts up to 2020. Figure 4 provides more detail of how prices of major grains, oil and key fertilisers have changed from 2006 to April 2008. Table 3 emphasises the remarkable scale of these price rises over the last two years. We briefly discuss here two important questions which have a major bearing on all the challenges and proposals discussed in this paper and on the viability of staple crop intensification in Africa: what are the likely impacts of these high commodity prices? and how permanent are they?

High food prices have major damaging impacts on consumers, reducing their real incomes. This is particularly serious for the poor and extreme poor, who already spend a large proportion of their income on food purchases. Coastal African cities have been hit hardest by this, with dramatic rice price increases affecting the urban poor and leading to riots in some cities. Supplies are also affected as traders have difficulty in raising capital to purchase stocks, and if those with capital are able to hoard then this also reduces supplies. Rural food deficit

**Figure 3. Commodity price indices 1980 to 2020 (2005 prices, 2005=1)**

Source: World Bank data




producers may be less affected in the short term, depending upon seasonal deficits and surpluses and links to international markets, and the extent of local speculative behaviour, but there are indications that prices in landlocked countries in East and Southern Africa have already been rising in comparison with previous years. High fertiliser prices (see below) and possible fertiliser shortages may be expected to lead to lower food production in the future. High food prices damage the livelihoods of the poor, increase food insecurity, and depress rural economic growth, diversification and accumulation of human, financial, physical, natural and often social capital.

Fertiliser price indices have risen more than maize and (for fertilisers including phosphates) rice price indices. This threatens the profitability and affordability of fertiliser acquisition and use for national economies, governments and farmers. Table 4 shows how European fertiliser price rises impact on Malawian prices (using a constant ratio of international to farm gate urea prices[2]) and how this then raises the breakeven price of maize required for its profitable use on maize (to achieve a value cost ratio – VCR - of 2) with two different grain : nutrient response ratios (a ratio of 20 is considered to be above average). Prices of $300 per tonne have occurred in Malawi in the past, at times of severe food shortage and hardship. With a grain: nutrient ration of 15, current 2008/9 urea prices mean that urea use is barely profitable even at import parity prices (allowing for around $100 per tonne transport cost to be added to the SAFEX futures price at current exchange rates). For countries without minerals, high grain and fertiliser prices (coupled with relatively low prices

**Figure 4. Commodity price indices 2006 to 2008 (2005 prices, 2005=1)**

Source: World Bank data. Beverage price movements are similar to cotton

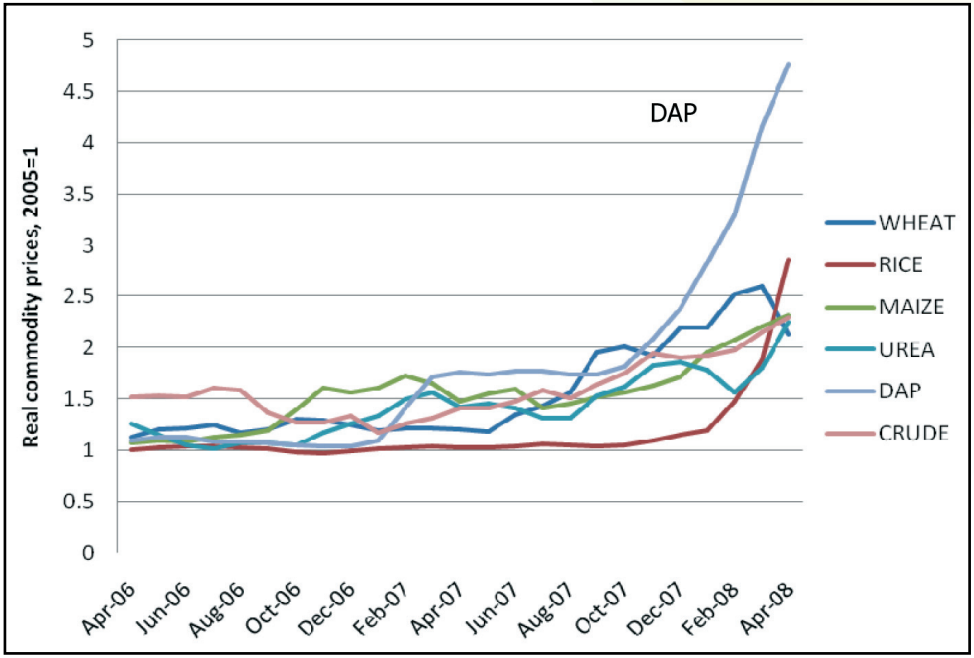



**Table 3. Commodity price ratios, May 2008/ Jan-Mar 2007**

| | | | | | | |
|---|---|---|---|---|---|---|
| May 2008/ Jan-Mar 2007 | | | | | | |
| Energy | Crude oil | 2.1 | Natural gas | 1.5 | | |
| Fertilizer | Phosphate | 8.1 | DAP | 3.5 | Urea | 2.1 |
| Grains | Rice | 2.9 | Wheat | 1.7 | Maize | 1.4 |
| May 2008/ Jan-Dec 2006 | | | | | | |
| Energy | Crude oil | 1.9 | Natural gas | 1.6 | | |
| Fertilizer | Phosphate | 8.3 | DAP | 4.6 | Urea | 2.8 |
| Grains | Rice | 3.1 | Wheat | 1.7 | Maize | 2.0 |
| | | | | | | |

.Source: World Bank pink sheets

for agricultural export commodities such as tea, coffee and tobacco) are likely to lead to an economic downturn and fiscal and balance of payments problems, further threatening investment, growth, food security and poverty reduction.

The World Bank price forecasts for grain, fertiliser and oil prices in Figure 3 with other forecasts

**Table 4. Malawian breakeven maize prices with changing urea prices**

| Year | Urea price $/mt | | Grain: N ratio | Maize prices $/mt | | |
|---|---|---|---|---|---|---|
| | Europe | Malawi | | B/E | Actual | SAFEX |
| 2006/7 | 220 | 470 | 15 | 135 | 100 – 160 | 250 |
| 2007/8 | 290 | 590 | 15 | 170 | 140 – 430 | 235 |
| 2008/9a | 630 | 1,260 | 15 | 365 | ??? | 275 |
| 2006/7 | 220 | 470 | 20 | 100 | 100 – 160 | 250 |
| 2007/8 | 290 | 590 | 20 | 130 | 140 – 430 | 235 |
| 2008/9a | 630 | 1,260 | 20 | 275 | ??? | 275 |

Source: adapted from Dorward and Poulton (2008)

generally predict prices falling back from their current high levels, but with grain and oil prices remaining at around their 2007 levels (in real terms) and fertilisers dropping back to their lower 2005 levels. If these estimates of equilibrium prices are correct they are probably very helpful to sustainable intensification of cereal crops in Africa, but the length of time it takes to get back to these levels presents major challenges, and in the interim significant long term damage to people's welfare and to African economies can be expected. We may also question if these forecasts are accurate, given the failure of such models to forecast the current high prices and the possible long term effects of new and very large commodity index funds on commodity prices (Masters 2008), a significant new factor in commodity markets which does not seem to be factored into many debates on the causes of current high commodity prices.

## 4. Coordination challenges and responses

### 4.1. Defining the challenges

The importance of coordination ("effort or measures designed to make players .... act in a common or complementary way or toward a common goal", Poulton et al. 2004: p521) is a recurring theme across discussion of the causes of poor agricultural performance in Africa and potential state interventions to subsidise inputs, develop credit and other financial systems, and stabilise prices.

We distinguish between three important and related levels of coordination which we term the micro, meso and macro levels of coordination.

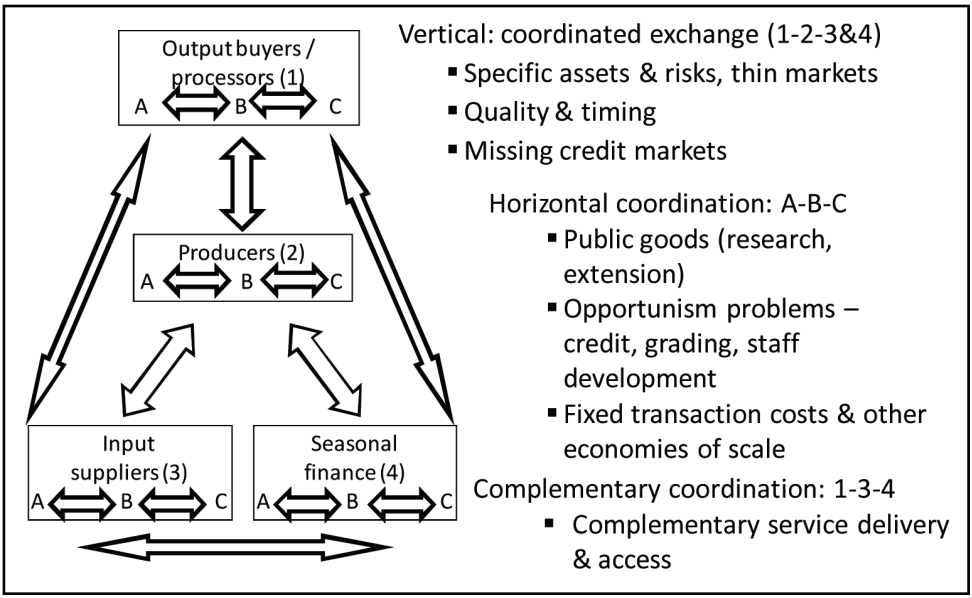
At a micro level, producers and consumers need low cost and reliable access to staple markets, and information about the behaviour of those markets. For increased productivity, farmers need access to technical production information and market and business information related to new production methods. They also require access to any inputs needed as well as finance for purchasing such inputs and perhaps for increasing their labour use. Some technologies may need access to particular production or processing equipment or services. Access to the different information, items and services needed for increased productivity needs to be coordinated in that the absence of just one of these may prevent adoption of increased production methods and/or significant reduction of production or economic benefits from adoption. This need for micro level coordinated access to resources and services is needed not just by producers and consumers but by other actors in the supply chain too – for

example input suppliers need access to finance, inputs, information about probable demand for inputs and prices, transport, storage facilities, etc. Produce traders have a similar set of information, service and capital demands, while technical and business extension services need financial, human, physical and informational resources. Each set of actors in a supply chain therefore requires access to complementary resources, services and information and must coordinate their own access to and use of these. The more complex a production system, in terms of its different resource, service and information needs, the greater the micro level coordination and management challenge and risks involved, and the greater the number of other actors each actor needs to coordinate with.

This leads to the meso-level coordination challenge, across the different actors: essentially each actor needs to be able to rely on and coordinate with other actors if they are going to overcome their own micro-level coordination challenges. This requires coordination across actors. It is helpful here to distinguish between three types of meso level coordination: vertical coordination along a supply chain, horizontal coordination between competitors performing the same function in a supply chain, and complementary coordination between providers of complementary services in a supply chain. The nature of and relationship between these different types of coordination are illustrated in figure 5.

Where flourishing markets exist (with large numbers of players, good information and established norms of behaviour) then markets can provide an effective coordination mechanism for goods and services with private good characteristics (where investments in the production or delivery of these goods and services yield major direct benefits to the actors making such investments). Problems arise, however, where such markets do not already exist. Vertical, horizontal and complementary

**Figure 5. Vertical, horizontal and complementary coordination**



coordination may also be developed within firms – indeed, this is what large firms do. This is not possible with many small farms, although firms can provide vertical and complementary coordination around small farms, particularly if farmer organisations can provide horizontal coordination. Unfortunately the incentives for large firms to provide such coordination are normally weak in dispersed, risky and low value staple food crops markets – this is not the case with some cash crops, where contract farming, for example, can be an effective meso-level coordination mechanism.

The challenges in meso-level coordination increase with

- the complexity and number of factors and actors involved in the micro level challenges facing each actor, and hence along the supply chain as a whole
- the absence of existing actors and relationships between them in a supply chain or related supply chain
- the value of new investments at risk for any actor and the potential losses incurred in the event of a coordination failure.
- lack of trust, of strong institutions or of large potential gains encouraging actors to cooperate and discouraging actors from behaving in opportunistic ways for short term personal gain.
- particular informational or production features of goods, services and processes (examples include problems posed by the need for critical timing of delivery of particular goods or services – such as seeds or fertilizers - , or information difficulties regarding particular attributes of actors or goods or services – such as seed or fertilizer quality or credit borrowers' repayment intentions)

It should be apparent that given the limited economic activity, weak institutions and seasonal nature of agricultural production there are substantial meso-level coordination challenges involved in many of the innovations that are likely to be involved in increasing staple crop productivity. However these will differ between different innovations and different crop types. Thus increasing root crop productivity based initially on improved planting material may not pose as many meso-level coordination challenges as cereal crop intensification involving investments in inorganic and seed input supply systems, knowledge intensive production innovations, and significant seasonal capital investments by input suppliers and farmers. Risks in root crop productivity innovations are also lower not just as a result of their lower seasonal investment requirements but also because the ability to store the crop in the ground reduces market and price risks for farmers.

The third, macro-level of coordination is concerned with the need for coordination of policies and investment in public goods and services to support the meso-level coordination needed for individual entrepreneurs' or actors' micro-level coordination of their activities. This is concerned with targeting and sequencing of provision of wider conditions needed for meso-level coordination between actors, and may involve meso- and micro-level action by the state and state agencies. Examples of specific macro-level coordination include policies and investments in road infrastructure; in agricultural research and extension service development; and in input subsidy and price stabilisation policies (as discussed later). These, however, also have to be coordinated with wider policies regarding macro-economic and fiscal management, private sector development, tax and legal frameworks for businesses and cooperatives, education, and social protection. Macro-level coordination is both particularly important and particularly challenging in situations where markets are poorly developed, governments have restricted human and other resources, and

information and governance systems are weak.

### 4.2. Potential AGRA actions

In one sense a large part of AGRA's activities within and across its programmes can be seen as specifically working towards the solution of meso and macro level coordination problems – for example with regard to research and extensions services or work on seed and fertiliser supply systems. Many of the specific recommendations made in the remainder of this paper regarding input subsidies, credit, and price stabilisation are also concerned with addressing particular coordination problems in intensification of staple food production.

In addition to these, however, AGRA may be well placed to fund and/ or facilitate regional or national processes and fora that either seek to promote

- coordination between different actors involved in or potentially involved in a supply chain or
- learning across supply chains or countries regarding experience of challenges and successes in developing meso-level coordination.

Multi-stakeholder discussions to improve the performance of supply chains are common in traditional export cash crop systems, but less so for staple foods. The wider range of actors (consumers as well as producers), at times with conflicting agendas, but rarely effectively organised for dialogue, may be some of the reasons for this. However, in the wake of the food crisis, one can foresee the establishment of various Presidential Commissions (or similar) to look into the performance of food systems in Africa. AGRA could seek to contribute to these, perhaps offering technical advice. The aim would be to capitalise on the political opportunity presented and to encourage the Commissions to engage a wide range of stakeholders in developing strategies to:

- promote technology adoption for production intensification by both surplus and deficit producers
- at prices that poor consumers can afford
- including measures to reduce volatility of prices for the benefit of both consumers and producers.

The following sections of this paper discuss key elements of such strategies and how they fit together.

As a longer-term project, AGRA may also seek to engage different public sector, private sector and farmer organisation actors with mutual interests or potential mutual interests in the development of a specific part of a supply chain. The aim of such engagement would be to help develop trust and shared understanding of the potential benefits from better coordination, the challenges in achieving this, and mechanisms by which it may be achieved and maintained. It could then bring actors together in a set of facilitated meetings and/or in joint pilot activities clearly focussed on a particular problem or set of problems. While the primary focus of such activities would be on problem solving, attention should also be given to the potential wider benefits of developing among supply chain stakeholders relationships of trust and a common identification of constraints. The specific problems that such activities would focus on could include a wide variety of issues regarding, for example, technical aspects of fertiliser formulations for particular areas and soils, systems for bulk orders and financing of seed and fertiliser inputs, the development of small agrodealer networks and roles, or the establishment and operation of interlocking arrangements to allow for farmer organisation members accessing inputs on credit

Finally, coordination is undermined by opportunistic behaviour by players in supply chains – including governments. An important issue that arises at many points in this paper is the need for systems that limit the incentives and

opportunities for short term opportunistic behaviour by governments. AGRA may play a role in highlighting these issues and in promoting regional agreements regarding trade in food, price stabilisation, or input subsidies, for example.

## 5. Profitability and input subsidies

### 5.1. Input subsidies and the profitability challenge

The price productivity tightrope challenge identified in table 2 arises because

1. producers need high returns from investment in new technologies in order to provide them with incentives to invest in productivity increasing technologies,
2. high returns need high food prices and/or low input prices and/or high output /input ratios
3. but poor consumers need low prices for food security, for welfare, and to raise real incomes to drive and support growth

This is a particular problem for cereal intensification, due to the higher investments needed in inputs, as compared with root crop intensification which, initially at any rate, requires a relatively low-cost switch to improved varieties through a one-time adoption of new planting materials. To encourage cereal intensification, therefore, policy needs to tread a fine line between providing attractive incentives to producers to adopt new technologies and keeping cereals prices low enough (and preferably declining in real terms over time) such that staple foods are readily accessible to poor consumers.

The logic of the food tightrope problem leads to the identification of the following broad approaches in dealing with it:

1. Raising physical productivity of inputs – through adaptation of technologies and farmer learning of how to manage them, and when (and when not) to use them
2. Reducing the costs of inputs by increasing efficiencies in (for example) fertiliser or seed production and/or delivery systems
3. Reducing farmers' input costs through input subsidies
4. Reducing the price margin between farm gate sales and consumer purchase by increasing efficiencies in (for example) grain purchasing, storage, and transport
5. Reducing the price margin between farm gate sales and consumer purchases by subsidising farm gate sales and/or consumer purchases
6. Raising the incomes of poor consumers through social protection subsidies (for example safety nets or targeted welfare payments)

In the long run raising technical and economic efficiency (points 1, 2 and 4 above), should provide the main solution to the food price tightrope problem, together with higher consumer incomes (as a result of economic growth). In the short run, however, the food price tightrope can be a major constraint to development in poor rural economies. Governments have tried to address this through different combinations of inputs subsidies, output price subsidies for farmers and for consumers, and social protection to raise the incomes of the poor. Coordination of these policies is a challenging but important example of the macro-level coordination discussed above.

Improved input productivity and increased efficiencies in input supply systems are the focus of elements of AGRA's PASS, of the proposed Soil Health Programme, and of the water programme. Direct general food price subsidies for consumers have proved to be very expensive and difficult to manage in the past and are not commonly implemented, although targeted consumer subsidies (for example through food for work and food transfers) and targeted income support are increasingly common.

## Box 1. Rethinking Input Subsidies

Conventional thinking on input subsidies identified their major benefits as: supporting the adoption of new technologies; promoting development in more remote areas (through pan territorial pricing and subsidised delivery systems); overcoming temporary inefficiencies from farmers' lack of knowledge of new inputs and of their benefits and from low output prices; providing time for farmers to gain experience in managing new technologies; and increasing the profitability of input use (credit programmes were generally implemented at the same time to address the affordability problem).

Input subsidy problems are well documented. These include their tendency to lead to inefficient input use; the tendency for their scale and costs to grow; difficulties in phasing them out even if they are not serving any wider social benefits; their politicization; the main direct beneficiaries being less poor farmers; and crowding out of private sector development by inefficient parastatals. Underlying many of these difficulties is the 'dark side' of subsidies, their tendency to promote and be affected by corruption, diversion of rents, and patronage.

New thinking on input (particularly fertiliser) subsidies in Africa has arisen in the last few years. Input subsidies have become more common, with different modes of implementation and a variety of often unstated objectives. These objectives include (in addition to many of the conventional arguments listed above) short term private input market development; replenishment of soil fertility; social protection for poor subsidy recipients; national and household food security; and meeting broad based political demands.

Some of these objectives, however, were not important in successful Asian Green Revolutions (for example replenishment of soil fertility, and social protection for poor subsidy recipients) whereas there were other, more important, outcomes from subsidy use in these green revolutions or in more recent input subsidy programmes. These include long term 'thickening' of supply chains and rural markets, lower staple food prices and higher wages and increased real incomes for poor non-recipients. These then led to longer term structural changes in livelihoods and the rural and national economy, with expanded domestic demand for higher value livestock and horticultural products and for non farm goods and services together with expanded supply capacity, due to release of land and labour as a result of increased staple crop productivity (Hazell and Rosegrant 2000; Dorward et al. 2004; Timmer 2004; Gregory 2006).

New thinking on the functions or roles of subsidies has led to an emphasis on new kinds of 'smart subsidies' which, as compared with previous general price subsidies, are designed to promote input market development (ie encourage development of more capable and efficient supply systems) and to provide more leverage in determining subsidy rates, targeting, coverage and cost (allowing, for example, a larger subsidy on a limited volume of inputs to targeted farmers, to control costs).

Major challenges continue in addressing old problems, sometimes in new forms. These include the need to reduce economic inefficiencies (particularly displacement of commercial private supply); to increase technical efficiencies; to control costs; to maximise indirect benefits through food prices and wages; to control parastatal inefficiency; and to promote private sector engagement and investment in supply systems. These challenges in turn need innovative business systems, political commitment with consistent and transparent policies and procedures, private sector commitment, determination of a programme size that is affordable but large enough to drive indirect market

These could be described as part of general moves in subsidies that involve switches from general to 'smart' subsidies and from loosely defined narrow objectives to tightly defined broader objectives. A similar pattern may be observed with regard to input subsidies, the

subject of the remainder of this section of the paper.

Constraints on increased input use can be usefully considered in terms of supply and demand constraints. Fertiliser supply problems include high transport costs to landlocked countries and within rural areas, long lead times in placing orders, uncertainty regarding government interventions and farmer demand, small markets, limited access to working capital, and exchange rate risk. These problems are exacerbated by recent dramatic increases in oil and fertiliser prices, and shortages of fertiliser. Many similar problems are faced in seed supply, though they arise in very different ways.

Fertilizer demand problems include low profitability of high cost inputs, significant output price and weather risks, problems of affordability (given high fertiliser prices relative to the incomes of poor farmers), ineffective fertiliser use and hence low physical grain to nutrient responses. The latter are related to poor extension information, low/variable output prices, lack of financial services, late and unreliable deliveries, inappropriate formulations, low yield potential crop varieties, lack of complementary soil fertility management practices, and, at times, poor rainfall. There are many similar demand problems with seeds, though there are probably bigger issues with farmers concerns about seed characteristics other than yield (for example drought and pest resistance, storage and eating qualities) and about seed quality (in terms of germination and varietal characteristics).

Input subsidies can rapidly (but partially) address or help with many, but not all, of the supply and demand problems described above. They most immediately and importantly increase profitability of on-farm use and, if sufficiently large, can bring down the price sufficiently to also address the affordability problem[3]. However there should be long term goals that input subsidies (with building of roads, of research, and of farmers' technical and business skills) should over time lead to improved efficiency of input supply systems and use and to economic structural changes. These together should then allow profitable use of unsubsidised inputs at acceptable prices so that subsidies can be reduced

A major conclusion from successful and unsuccessful experience with input subsidies is that they can make very significant contributions to food security, poverty reduction and economic growth (see, for example, Box 2). However, their benefits depend upon an effective basic input technology (in terms of its potential to raise yields of marketable produce), good programme design and implementation, and indirect subsidy impacts on staple prices, the rural economy and wages. These in turn require prior and complementary investment in public goods (roads, agricultural research and extension, market development infrastructure). complementary policy and service coordination (regarding, for example, policies to encourage stable prices, social protection, private sector involvement and development, good fiscal management, and a clear national development strategy), political commitment to the implementation and goals of the programme, and the financial and organisational resources for coordinated implementation.

Critical issues regarding design and implementation concern

(a) programme scale (cost, subsidy volume and subsidy rate),
(b) the basic input supply system (the timing and processes for determining input requirements and for importation),
(c) input distribution networks (determination of approved subsidised input selling agents),
(d) beneficiary targeting,
(e) voucher (or other entitlement) system and distribution to beneficiaries,

(f) voucher redemption and input purchase by beneficiaries,
(g) voucher redemption by input sellers,
(h) financial systems as regards margins and payments for goods and services,
(i) performance monitoring and audit systems (including incentives for good performance and penalties for poor performance or fraud).

## Box 2. Malawi's 2005/6 to 2007/8 Input subsidy programme

Following experience with general maize input subsidies from the 1970s to 1990s and subsequently with 'starter packs' and 'targeted input programmes', from 2005/6 Malawi has implemented a large scale input subsidy programme using vouchers. There is a strong cross party political consensus on the need for fertiliser subsidies, and strong government commitment to the programme, but opposition criticisms regarding the use of vouchers (as opposed to a general price subsidy) and reports of corruption.

In 2006/7 the programme involved distribution of redeemable vouchers for maize (85%) and tobacco fertilisers with a subsidy of around 70%. Both private sector companies and parastatals were involved in importation and sales of subsidised fertilisers (in 2005/6 only parastatals had sold subsidised fertilisers), but only in 2007/8 did small agro-dealers become involved.

Malawi Input Subsidy Programme, key statistics 2005/6 – 2007/8

| | 2005/6 | 2006/7 | 2007/8 |
|---|---|---|---|
| Subsidised fertiliser sales ('000MT) | 132 | 175 | 208 |
| Subsidised fertiliser sales ('000 coupons) | 2,640 | 3,500 | 4,160 |
| % by private sector | 0 | 28% | 24% |
| % farmers receiving coupons - actual | 50%(est) | 54% | NA |
| Average coupons / recipient - actual | 1.8(est) | 2.0 | NA |
| Subsidised maize seed sales (MT) | NA | 4,500 | 5540 |
| Programme cost ($ million) | 51 | 74 | NA |
| Fertiliser subsidy cost ($ million) | NA | 63 | 100 |
| Delivered fertiliser price $/MT | NA | 490 | 590 |
| European urea price ($/MT) | 220 | 220 | 290 |
| Incremental fertiliser sales (as % subsidy sales) | 70-80% | 60-70% | NA |
| Incremental maize production (MT) | 550,000 | 700,000 | NA |

sensitive to yield responses and to maize and fertiliser prices. The 2006/7 benefit : cost ratio was estimated to lie between 0.75 to 1.36 (depending on fertiliser response rates and maize prices used in the calculation) with a best estimate of around 1.1 and potential for substantial improvement with more timely and better targeted input distribution. Possible alternative weather scenarios generated benefit : cost ratios ranging from 0.65 to 1.59 (allowing for uncertainty in rainfall and maize prices and for a 30% increase in fertiliser prices).

A financial analysis of government costs and returns found that net returns are very sensitive to displacement rates, and that the programme cannot be justified solely by its contribution to

reducing government financing of food imports in years of poor production: other approaches to securing grain supplies and price stabilisation may be more efficient and effective than a subsidy programme.

Qualitative interviews and rural livelihood and economy modelling found that the major benefits of the 2005/6 programme and good weather were improved food security, low maize prices in the following year, and increased wage rates which led to increased rural investments, and improved social relationships and welfare perceptions. These led to increases in real incomes for deficit food producers and beneficial stimulation of the rural economy. Higher maize prices due to exports prompted by overestimates of maize stocks following the 2006/7 programme will have undermined these benefits.

Major issues emerging from this include the need for clear development objectives, for better market and production information, for complementary policies (in maize trade and prices, social protection, wider soil fertility research and extension, and infrastructural investments), for clearer criteria for determining the scale of the programme and for sharing and controlling costs, for improved logistics and implementation and timing of distribution, and for systems that control fraud. There are major practical, efficiency, equity and political questions regarding targeting (should there be targeting, and if so by household or community, for example, and using what criteria and methods?). There are also challenges and opportunities in improving private sector engagement, particularly for agrodealers and remoter areas. There are also major potential opportunities for using a range of innovative technologies and systems for addressing these issues. However current international fertilizer and maize prices pose major challenges to the cost and affordability of the programme and to its economic and livelihood benefits.

**Sources:** Logistics Unit 2008; School of Oriental and African Studies et al. 2008

Many of these issues are strongly inter-related, so that particular design and implementation features have implications (and pose different advantages and disadvantages) across different issues.

### 5.2. Potential AGRA actions

There is considerable urgency in the need to improve the effectiveness of input subsidies as global commodity price increases lead to both increasing political pressures for governments to use them and increasing costs which threaten their profitability and affordability.

AGRA can play a very valuable role in working with governments, farmers, agro-dealers, fertiliser importers and distributors and seed companies to investigate, develop and implement good practice in input subsidy programmes. This should involve a programme of innovative action research, evaluation, shared lesson learning, and capacity building, and should work at different levels. Integration with AGRA's "Programme for Africa's Seed Systems" (PASS) and Soil Health Programme (AGRA, 2007) will be important as they have important components addressing the development of seed and fertilizer supply systems. Development and improved operation of these systems are important objectives of and elements in input subsidy programmes.

#### 5.2.1. Comprehensive review of input subsidy experience

There is an urgent and important need for a thorough review of experience with and lessons from input subsidies around the world in the last 50 years. The brief review above and in Box 1 of new thinking about impacts and modalities of subsidies suggests that there are important

questions that need investigation about past and present successes and failures in agricultural input subsidy programmes. A new look at these questions is needed to investigate a wider set of impacts than has been considered in the past (including in particular the role of subsidies in promoting structural change), and a broader set of implementation issues regarding subsidies themselves (their mode, sequencing and policy context) and the complementary policies needed for these wider impacts to be achieved. This could involve an initial workshop bringing together experience from Asia and Africa to produce a preliminary synthesis setting out (a) clear lessons from past experience, (b) outstanding research needs, and (c) the terms of reference for further research addressing particular questions across different countries and/or investigating in more depth particular countries' experience.

There is some urgency in such work, for two reasons. First, there is an urgent need for better information to guide input subsidy policy design, investment and implementation. Second, the successful implementation of input subsidies in many Asian green revolution countries occurred 40 to 50 years ago. Many professionals who were involved as implementers or analysts have already retired: there is limited time to ask new questions about these historical events and processes.

### 5.2.2. Support to CAADP and the African Development Bank in implementation of the Abuja Summit Action Plan

The Abuja Fertiliser Summit Action Plan involved proposed support for lesson learning about subsidy programme experience, the establishment of an African Fertilizer Financing Development Mechanism, and the development of coordinated purchase & supply systems. There has been some action on these, particularly in the last few weeks in response to fertiliser shortages, but overall progress has been slow. AGRA may be able to make a substantial contribution to moving these initiatives forward, both by working with CAADP, the ADB and RECs and by committing resources to these activities as part of its own programmes (as advocated below).

### 5.2.3. Improving integration with complementary policies

An important component of successful Asian Green Revolutions was high levels of spending on input subsidies and on complementary investments in roads, research and extension, and price stabilisation. The limited financial resources of African governments have meant that input subsidies and these complementary investments have instead been seen as competing alternatives. Recent positive growth trends in many African countries plus renewed commitment to agriculture amongst some donors has the potential to ease resource constraints, although the food crisis could offset many of these benefits. AGRA could play a role in investigating investment priorities and in advocacy for greater and more balanced investment in complementary investments. In particular, it should ensure that implementation of fertiliser subsidy programmes is accompanied by a public debate within the countries concerned regarding the appropriate balance in expenditure between short-term subsidies and longer-term investments in agricultural public goods. Finally AGRA can directly support complementary investments in ways that maximise synergies with fertiliser subsidies, building upon its existing and planned investments in seed development and in soil health.

### 5.2.4. Programme scale: cost, volume, and subsidy rates

Governments currently operating or considering the introduction of input subsidy programmes face major questions regarding the optimal scale of such programmes in terms of their overall cost, the volume of inputs to be subsidised, and the rate of subsidy. Although these are related to more detailed design and implementation issues discussed below (particularly questions about targeting), these questions also need separate and often higher level consideration relating limited budgetary resources to minimum scale needed to get market impacts. AGRA could usefully fund research and engage governments in debate on these issues with a view to developing, for example, regional good practice guidelines. Country commitment to these guidelines could yield a number of benefits in terms of better design of programmes, and could also be an important mechanism in combating the politicization of input subsidies and its tendency to inflate costs.

### 5.2.5. Piloting of system innovations

As noted throughout our discussion of input subsidies, there is considerable need for improving subsidy programme design and implementation. Table 5 shows how particular types of innovation (in columns) relate to the major issues in system design identified earlier (in rows). Strong interactions are important. We now briefly discuss the possible innovations listed in table 5 and the potential for AGRA to support their development, implementation

**Table 5. Input subsidy system innovations and issues**

| | System innovations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Major subsidy design issues | targeting | flexible/ fixed price vouchers | smart cards etc | remoteness incentives | complementary integration | audit systems & penalties | stakeholder engagement | performance targets |
| subsidy scale, volume and rates | X | | | | | | | |
| basic input supply system | | | | | | | X | X |
| input distribution networks | | X | X | | | X | X | X |
| beneficiary targeting | X | X | X | | X | | | X |
| voucher system and distribution to beneficiaries, | X | X | X | | | X | | X |
| voucher redemption by beneficiaries, | | X | X | X | X | X | X | X |
| voucher redemption by input sellers | | X | X | X | | X | X | X |
| financial systems | | X | X | | | X | X | X |
| performance monitoring and audit systems | X | X | X | | | X | X | X |

and evaluation. These should focus on controlling subsidy volumes and reducing costs; promoting more efficient on-farm input use; promoting incremental input use (rather than displacement); reducing fraud and misuse of subsidies; encouraging private sector and particularly agro-dealer investment and services in remoter areas; and encouraging rather than impeding livelihood shifts from reliance on low productivity staple activities to higher productivity staple, non staple and non-farm activities. Greater national and household food security should follow from this.

**5.2.5.1. Targeting systems**

The targeting of subsidized inputs to different groups or types of people is a critical and sensitive issue, and some form of implicit or explicit targeting is inevitable unless a universal and equitable subsidy is implemented. It is helpful to distinguish two principle levels of targeting – geographical targeting (between regions, districts and different geographically defined communities) and intra-community targeting (between different categories of people or households within communities). Geographical differences between areas and communities will often be correlated with agro-ecological, socio-economic and cultural differences between these areas and communities. The distribution of subsidized inputs between different categories of people then depends upon the interaction of formal criteria determining geographical targeting and intra-community targeting together with 'informal' de facto criteria and mechanisms which are actually implemented.

A criticism of conventional general price subsidies is that the direct beneficiaries tend to be less poor. A tendency of less poor farmers to predominate among beneficiaries has also been observed in Zambia (Jayne et al. 2007) and to a lesser extent in Malawi in 2006/7 (though pro-poor targeting under the earlier TIPS programme, although controversial, does seem to have been more effective). In a country such as Kenya any crop input subsidy will bypass pastoralists in semi arid and arid areas. In Malawi in 2005/6 and 2006/7 district voucher allocations were made on the basis of cultivated maize areas, tending to exclude farmers in non-maize growing areas and, among maize growing areas, giving higher subsidy volumes per household to areas with larger holdings. If, however, targeting were to be conducted purely on the basis of individual household need, without prior allocation to different areas, then most of the subsidy would go to the southern region.

A final issue concerns average income levels in a country. Average rural incomes are several times higher in Kenya than in, say, Malawi or Mozambique. Whilst universal coverage may be appropriate for a subsidy programme in Malawi, the case for targeting is arguably stronger in Kenya[4].

This brief discussion raises serious political, economic, welfare and equity issues associated with targeting. Targeting criteria and methods have to be constrained by political concerns and practicalities (at national, regional and community levels), by programme objectives (for example production, growth, or social protection objectives), and by the feasibility and costs of targeting. There may be arguments for comprehensive or area targeting that delivers smaller quantities of inputs (or of entitlements to inputs) to all households or farmers in a country or area.

This is an issue that AGRA could usefully explore by working with governments who are implementing input subsidies to consider and pilot different approaches.

#### 5.2.5.2. Voucher systems

There appear to be significant advantages in using vouchers rather than general price subsidies or physical deliveries of subsidised inputs. These include: the ability to limit the cost of the programme by limiting the number of vouchers; easier targeting to particular household types, and reduction in cross-border leakage. However, there are also a number of different ways that voucher systems can be implemented. These have wide ranging effects which include, for example, options for control of security and fraud in disbursement and redemption, the extent of choice that beneficiaries have between different inputs and suppliers, options for beneficiaries to trade subsidy entitlements and their tradeable value, political constraints on subsidy reduction and withdrawal, gendered control of subsidised inputs within households, and the ability of governments to control subsidy programme costs within and between years.

In simpler systems (as implemented in the Malawian fertiliser subsidy) a voucher entitles a named bearer to subsidised purchase of a fixed quantity of a specified input. Variations on this may allow beneficiaries some choice in which inputs to purchase (as implemented in the Malawian seed subsidy from 2006/7), and this is a move towards vouchers with fixed face values. Development of security and anti-fraud systems and features are very important, and there may be trade-offs between flexibility in voucher use and security. Linking voucher issue and redemption to ID cards and/or the use of barcodes for uniquely identifying vouchers are relatively simple and low technology options for improving security, but they have their own challenges in different circumstances. Malawi, for example, has no national ID system, while use of barcodes needs careful system design, and barcode readers must be able to operate in areas with no electricity. More radical innovations might involve the use of electronic cash cards, biometric smart cards, and mobile phone accounts. Each of these offer different and sometimes substantial potential benefits but pose different political, technical, administrative and social challenges within communities and households (the use of biometric information, for example, raises questions about intra-household control over input subsidy entitlements). Many of these have ramifications which extend beyond an input subsidy programme.

AGRA could play an important role in promoting the development and piloting of a variety of different voucher systems.

#### 5.2.5.3. Remoteness incentives

People in remote areas face particular problems in accessing inputs, and often also in accessing staple food markets - as consumers or producers. Since costs are high and volumes low, private companies are slow to move in, and this means that governments tend to be much more directly and actively involved in disbursing subsidised inputs in such areas. There are major challenges in maintaining services in such areas and at the same time encouraging private sector activity.

There is some experience that small agrodealers are able to operate in these areas more profitably than larger input supply companies, but there are particular administrative challenges in governments disbursing inputs subsidies through small informal agrodealer businesses. There will also be a need to develop incentives to encourage agrodealers and other private input suppliers to provide input selling services in remote areas.

This is another area where AGRA could develop pilot systems, (a) administrative systems for working with agrodealers and (b) financial systems for providing efficient incentives for agrodealer participation in these systems. There will be close synergies with work in AGRA's PASS and soil health programme, with the development and piloting of voucher systems discussed above, and with systems for auditing and for

engaging with stakeholders (discussed below).

**5.2.5.4. Complementary integration**

This rather ambiguous heading is used to describe the need for input subsidy programmes to develop arrangements for subsidy targeting, entitlement, and redemption that complement other important aspects of development, and indeed that can increase the effectiveness of the subsidy programme. These may involve, for example: linkages between social protection and subsidies that facilitate access by poor people to subsidised inputs – or to higher subsidy rates; subsidy incentives that encourage farmers' adoption of integrated soil fertility management practices; special arrangements for farmer savings groups or clubs with specific emphasis on encouraging farmers to save up for the cost of coupon redemption or with systems that allow them to organise group redemption and bulk fertiliser transportation to their village. .

There are opportunities for AGRA to establish networks for developing and trialling such systems, and also for learning about and from ways in which farmers themselves and other stakeholders develop and implement new initiatives themselves.

**5.2.5.5. Audit systems & penalties**

Rigorous auditing and severe penalties for fraud are essential in programmes where there is such scope for fraud – whether on a large scale by a small number of people or on a small scale by large numbers of people. This should involve spot-checks on coupon distribution processes and outcomes, and on sales of subsidised inputs under the programme, followed by rigorous and substantial end of sales auditing of both parastatal and private sector agencies. Auditing should be backed up by strong penalties for organisations which either participate in fraudulent activities or fail to have proper procedures and penalties for preventing fraud by their employees.

AGRA could play a useful role as an independent actor financing and managing the development and implementation of audit systems.

**5.2.5.6. Systems for stakeholder engagement, performance targets & monitoring, trust, commitment**

'Smart' input subsidy systems that seek to promote private sector investment in input supply rely on good cooperation from a large number of stakeholders with a wide variety of interests: different government ministries, large and small private input suppliers, parastatals, politicians, farmers, civil society organisations, and consumers. The achievement of subsidy programme objectives requires some of these stakeholders to make considerable investments, at considerable risk. Stakeholders may also face substantial temptations to behave opportunistically, in their own short term interests, even though this may be damaging to other stakeholders and to the programme as a whole. Relationships between some stakeholders may also have been difficult in the past.

An important component of successful 'smart' input subsidy programmes is therefore likely to involve commitment from all stakeholders to the programme in the context of transparent systems of mutual commitment to particular activities, with clear performance targets and monitoring systems, clear lines of communication, and clear systems for resolving disputes and adapting to changing circumstances. The development of such systems requires a perception of mutual interest, time, resources, and realistic expectations. AGRA, with its resources and good relations with governments, private

sector actors, and farmers is well placed to take a major initiative in developing these systems.

## 6. Credit

Agricultural intensification, involving adoption of new technology, is a form of enterprise expansion and, therefore, requires capital. In theory, this could come from farm savings (retained profits), non-farm income sources (including wages, business earnings or remittances) or borrowing. In practice, small farm households are rarely able to save enough to fund significant intensification, whilst only a minority (normally amongst the better off) have access to sufficient non-farm income sources for the purpose. Therefore, credit has long been recognised as a priority to support agricultural intensification (Feder et al. 1985).

At the outset of this section, we note that this "supply-driven" orientation is somewhat at odds with the idealised "demand-led" orientation of microfinance theory. Thus, it has been recognised for some time that most rural households would benefit from (and, at reasonable prices, demand) a range of financial services, including savings services, insurance and money transmission to rural areas. Indeed, it is commonly argued (e.g. by Zeller and Sharma 2000) that more (and poorer) rural households could benefit from these alternative services than could benefit from credit. From the side of the service provider, provision of multiple services can spread overheads across greater volumes of business, thereby enhancing commercial sustainability[5]. There are also important (potential) complementarities between credit and other services, e.g.

- insurance of borrowers against crop failure
- savings as a signal of financial discipline and as guarantee against loan default.

Interventions by AGRA should, therefore, be supportive of – and certainly should not act as a disincentive towards – the development of rural financial institutions offering a range of financial services. However, given AGRA's objectives – and the central role that agricultural intensification is likely to play in stimulating growth in the entire rural economy - a specific focus on (seasonal) credit[6] is justified.

As outlined in previous sections, we recommend that AGRA supports subsidy programmes for poorer households to achieve both food security / social protection and growth objectives. However, for larger and/or more commercial smallholders, the quantities of inputs that could be accessed through these programmes would be insufficient to support further intensification. For such producers, seasonal credit is desirable to permit access to greater volumes of inputs. (These would be on top of vouchers, if vouchers were universal/widespread, or possibly "instead of" vouchers for some). Furthermore, as smaller farm enterprises develop on the basis of the subsidy programme, they could graduate to the credit programmes, with the balance of their dependence on vouchers and credit shifting towards the latter over time. Thus, credit programmes offer an eventual exit strategy from expensive subsidy programmes[7].

### 6.1. A Note on Fertiliser and Food Prices

Before we consider experience with, and recommendations for, seasonal credit programmes to support agricultural intensification, we note that credit performs a narrower role in support of agricultural intensification than subsidy. As argued above, a fertilizer subsidy not only tackles the affordability/cash constraint to agricultural intensification, it also raises the profitability of the farm enterprise to the producer, thereby providing a window of opportunity for

"learning [about a new technology] by doing" and/or partially compensating for the absence or poor quality of extension support. By contrast, credit only tackles the affordability/cash constraint. If credit is to be taken and successfully repaid, the technology that it is supporting must be clearly profitable for the producer. Moreover, acquiring full-price inputs on a credit basis entails greater risk than obtaining subsidised inputs with any balance paid up front in cash.

These observations provide some of the justification for targeting credit towards larger and/or more commercial smallholders, who have a greater ability to bear risk (due to greater assets and perhaps also a more diversified income portfolio) than poorer households and are often also "better" farmers, able to obtain higher returns to fertiliser application through good soil fertility management and timely undertaking of critical crop production tasks (e.g. planting, weeding, pest control). However, in the context of AGRA's overall aims and objectives, they also focus our attention back on the issue of current and projected fertiliser prices (Figures 3 and 4) and their implications for profitability of fertiliser use on staple foods. Future price trends are critical for AGRA's investment strategy.

On the one hand, African agricultural development can only proceed at food prices that are affordable by poor African consumers. On the other hand, credit will only encourage producers to intensify production of maize[8] using fertiliser if incremental application of fertiliser is profitable. World fertiliser prices are givens, even if measures can be taken to reduce the margins between these prices and the cost of fertiliser as delivered to African producers. Table 4 showed the break-even prices at which fertilizer application on maize in Malawi has been (will be) profitable over the past three seasons, using the rule-of-thumb that the value:cost ratio (VCR) for incremental application should exceed two for farmers to consider the benefit of additional fertiliser application to be worth the cost (additional labour, as well as cash) and risk.

Assuming that larger and/or more commercial producers can make more efficient use of fertiliser than poorer, multiply-constrained farm households, Table 4 calculated that it would be (marginally) profitable for such producers in Malawi to apply fertiliser at local 2007-08 season fertiliser prices if the producer price for maize was in the region of US$ 130 per ton. However, if a 20% interest charge is added onto the cost of fertilizer, this translates into a producer price of US$ 156 per ton and a consumer price that is already high for many poor households. Meanwhile, at current world fertiliser prices, the producer prices required to make fertiliser application profitable for African smallholders in the 2008/9 season are incompatible with basic food access by poor consumers. The projections in Table 3 suggest that world fertiliser prices will fall back to 2007 levels by 2009-10. If these prove correct, then there may be scope for promotion of unsubsidised fertiliser amongst more commercial smallholders through credit programmes in some African countries (especially coastal ones). However, if fertiliser prices do not fall back this far – and, in landlocked countries such as Malawi, possibly even if they do - credit programmes to promote fertiliser uptake may have to continue to be accompanied by a degree of fertiliser subsidy, albeit at a lower level than is offered through the main subsidy programme.

### 6.2. Rural Finance in Africa and the Particular Challenges Associated with Seasonal Credit

The microfinance revolution was in part a reaction against the widely perceived failure of previous, state-supported and subsidised agricultural credit programmes. These were fiscally unsustainable due to both the subsidy component and repayment problems, and the subsidy component rarely benefited poor households, as the majority of loans were given to well-connected, wealthy borrowers (Adams and Vogel 1986; Yaron 1992). By contrast, numerous microfinance organisations have been hugely innovative in providing financial services to poor clients – often much poorer than the average recipient of previous agricultural credit programmes. However, rather than developing a better model for seasonal credit provision to poor agricultural producers than the previous, state-supported and subsidised agricultural credit programmes, microfinance largely abandoned agriculture. In Africa, the modern microfinance industry emerged as a predominantly (peri-)urban phenomenon and only fairly recently has it begun to address the huge gap in rural financial service provision in Africa. Moreover, there are at least three reasons why, left entirely to market forces, even future progress in seasonal credit provision for smallholder agriculture is likely to be slow.

Firstly, the transaction costs associated with any (financial) service provision in rural Africa are high. Two main factors account for these high costs:

- low population densities and poor infrastructure lead to high costs in connecting with clients. Using FAO classifications, average population density9 in eastern Africa is 50 persons per km2 and in western Africa 46 persons per km2. Densities in southern and central Africa are even lower, giving a sub-continent average of only 35 persons per km2. By contrast, the comparable figure for (S/SE/E) Asia is 167 persons per km2 and for Bangladesh, one of the centres of global microfinance, it is around 1200 persons per km2.
- The small transaction sizes where clients are very poor. Many of the costs associated with a financial transaction (processing a deposit, authorising a loan or visiting a client to seek repayment) are fixed, irrespective of transaction value. However, the income stream for the financial institution is the interest payment, which is a function of transaction value.

Thus, Johnson et al. 2004 conceptualise a "frontier" of rural service provision, whereby little financial service provision is occurring in areas where both the population density is less than 300 persons per km2 and the poverty rate exceeds 40% of the local population10. This excludes much of rural Africa.

Secondly, conventional microfinance models are ill-suited to servicing seasonal agriculture (Dorward et al. 1998; Morduch 1999). Borrowers with highly seasonal incomes can only make very small payments at regular intervals, leaving most of their loan (perhaps all the principal and some of the interest) to be repaid at harvest time. This greatly increases the risk for the lender, who, in a Grameen-style model, relies on regular repayments as a signal that all is well with loan servicing. Moreover, disbursing and collecting all loans at once removes one mechanism for ensuring loan repayment, which is to provide members of a borrower group with staggered access to loans, with some repaying their loans first before others are allowed to take theirs out. Furthermore, groups that are all required to repay at once can face perverse incentives under conditions of covariant risk (conditions that are typical of smallholder agriculture in Africa)

whereby even borrowers who could repay decide not to when they see that their fellow group members are going to have difficulty repaying their loans (Stiglitz 1990; Besley and Coate 1995).

Thirdly, lending to smallholders in Africa entails particular risks. One source of risk is the widespread attitude - encouraged by a history of poorly managed government and donor credit programmes and sometimes encouraged by irresponsible political opportunism in newly democratic systems - that loans are, after all, really gifts. The resulting culture of "strategic default" (Poulton et al. 1998) raises the amount of effort required to screen borrowers to find trustworthy clients and to follow up to ensure repayment of loans granted[11]. This adds to costs of operation (Box 3). A second source of risk is the combination of high climatic variability and low levels of irrigation in Africa, which mean that even many well-intentioned borrowers may struggle to repay loans in bad seasons.

Given the multiple obstacles to seasonal credit provision in African agriculture, we should expect most shifts in the lending "frontier" to be incremental, advancing in ways that one obstacle can be tackled at a time. Thus, in western Kenya the microfinance organisation SAGA has successfully launched a so-called "Mkulima Loan" product targeted at smallholder farmers. At its launch it was targeted at two groups of borrowers: vegetable producers selling to Kisumu markets (i.e. quite strongly commercialised) and rice farmers on a large irrigation scheme located on the main road into Kisumu from Nairobi. Thus, the main risk was to take on seasonal lending, with most repayment expected after harvest. However, the choice of borrowers carefully minimised the costs of servicing borrowers and the risks associated with weather.

## Box 3 .The Break-Even Interest Rate

Given that revenue from a lending operation comes from the interest paid by borrowers, the break-even interest rate (at which the lender just recoups their costs through interest revenue) can be calculated as follows:

$i^* = (k + a + d) / (1 - d)$

where: $i^*$ = break-even interest rate

$k$ = cost of capital

$a$ = administrative costs per unit of currency lent

$d$ = default rate

$i^*$, $k$, $a$ and $d$ are all expressed in percentage terms.

Note that this assumes that the borrower advances no collateral to secure her loan, such that, if she defaults, the lender loses the principal as well as foregoing the expected interest payment.

Administrative costs include all overhead costs of running a financial operation as well as the staff and transport costs associated with identifying trustworthy clients, providing them with loans, then recovering those loans. Where prevailing attitudes raise "d", extra administrative costs ("a") have to be incurred to keep defaults to tolerable levels (ideally 2% or less for a microfinance organisation, although 5% is often considered good performance for seasonal agricultural loans in Africa).

If seasonal credit is to assist more widespread intensification of staple food production in SSA, multiple risks will have to be tackled. The (initial) focus on larger and/or more commercialised smallholders will tend to raise average loan sizes. However, as shown in the next section, they are still likely to be modest by international standards.

### 6.2.1 Average Loan Sizes

We have so far talked about larger and/or more commercialised smallholders without defining terms. Moreover, what constitutes a large smallholding varies by country. However, a hypothetical example might be useful to focus thinking. One bag of basal fertiliser and one bag of top dressing applied on a hectare of land would be a major increase on current fertiliser patterns in SSA. Assume that a household able to obtain four bags of fertiliser on credit chose to apply them across two hectares and that these hectares were fertilised in addition to another where the fertiliser was obtained through a subsidy scheme. According to Jayne et al. 2003, who examine smallholder land distributions across five countries of southern and eastern Africa, a household that cultivated three hectares of land would be in the top quartile of

**Table 6. Average Loan Sizes Reported for Selected Microfinance Organisations**

| Organisation / Scheme | Average Loan Size (US$) | Emphasis on Seasonal Lending? | Reported by |
|---|---|---|---|
| Africa | | | |
| SAGA "Mkulima loan" (2005) | $138 | Yes | Kibaara 2006 |
| Wedco (microenterprise, 2003) | $195 | No | Johnson et al. 2004 |
| MFIs in Karatina (average, 2003) | $299 | No | Johnson 2004 |
| FINCA, Uganda (1998) | $54 | No | Gibbons and Meehan 2000 |
| Other | | | |
| CARD, Philippines (1998) | $83 | No | Gibbons and Meehan 2000 |
| Grameen Bank, Bangladesh | $160 | No | Pretes 2002 |
| CRECER, Bolivia (1998) | $163 | No | Gibbons and Meehan 2000 |
| Financiera Calpiá, El Salvador (agricultural,1997) | $450 | Yes | Klein et al. 1999 |
| CMACs, Peru (agricultural, 1996) | $1607 | Yes | Klein et al. 1999 |
| BAAC, Thailand (1996) | $2286 | yes | Klein et al. 1999 |

Notes: a) These figures are for average outstanding loan size within the relevant portfolio, except for SAGA (average size of loans disbursed in the year in question) and Grameen (general figure).
b) The FINCA website indicates that the average loan size for its Uganda programme is now US$325, with an average outstanding loan size of US$226 per registered client (source: http://www.villagebanking.org/site/c.erKPI2PCIoE/b.2671211/k.BFD7/Uganda.htm, accessed 16/06/08)

the land distribution in Ethiopia, Rwanda and Mozambique and in the top half in Kenya and Zambia.

At current fertiliser prices in Africa, four bags cost US$200 (coastal country) to US$250 (land-locked). This is a considerable share of total household income, even for top quartile households, in all the countries mentioned except Kenya (Jayne et al. 2003), meaning that relatively few would be advised to bear the risk of taking out a loan of this size. Moreover, as already noted, current world fertiliser prices mean that fertiliser use is not profitable on maize in Africa at maize market prices that African consumers can afford.

As shown by Table 6, even an average loan of US$200 to US$250 is not large by microfinance standards. Indeed, excluding the final three cases (which are included to show that, where agricultural "microfinance" loans are available in other continents, they are generally much larger than those being contemplated for Africa), the examples in Table 6 have been selected as examples of organisations with below-average loan sizes, often taken as a proxy for good poverty outreach.

Indeed, Gobezie 2008 reports that "The MicroBanking Bulletin's definition of institutions reaching the low-end of the population includes those with an average loan size of less than 20% of GNP per capita or less than $150. The median is 43.5% for MFIs globally (see Rosenberg 2007)"

Meanwhile, if international fertiliser prices eventually return even to their mid-2007 levels (at which unsubsidised fertiliser use might again become compatible with affordable maize for African consumers), then the average loan size required to assist an African smallholder to access four bags of fertiliser could fall to US$100-120, which is indeed small by microfinance standards. From the lender's side, therefore, even targeting the top quartile of smallholder producers means dealing with smaller, higher cost loans than they typically deal with. It should be stressed that these small loan sizes are coupled with low population densities, and would therefore represent a considerable micro finance challenge even without the added difficulties created by seasonal lending.

### 6.2.2. New Technologies to Reduce Lending Costs

One of the major strengths of the microfinance industry is that it can draw on international expertise and can bring commercial dynamism and creativity to bear on problems such as those outlined above. Here we briefly review four innovations in financial service provision and assess their potential to reduce the costs of rural lending.

Ivatory and Mas 2008 review early experience with so-called "branchless banking", encompassing both use of mobile phone technology in the provision of financial services and the use of agents to deliver basic services to customers at lower costs than banks themselves can do. A prominent example of the former is the M-Pesa money transfer scheme developed by Safaricom in Kenya[12], whilst the latter usually involve some form of smart card (such as Malswitch in Malawi) to facilitate transactions. Whilst important cost savings (compared with traditional banking models) are reported from such approaches, an important finding is that, to date, they have mainly been used for money transfer, receipt of welfare payments and payment of utility bills. Hence, both mobile phone transfers and smart cards could be used in the delivery of fertiliser subsidies to rural households (as indeed is already being piloted in Kenya), but applications to credit are less obvious. Indeed, Ivatory and Mas 2008 note that, with few exceptions,

microfinance organisations have so far not adopted these new approaches. A likely reason for this is the importance of personal contact between loan agent and borrower in microlending, both for initial screening of trustworthy borrowers and for collection of loan repayment. In one (unspecified) case in Kenya, a microfinance organisation that allowed borrowers to make loan repayments through M-Pesa reportedly found that attendance at borrower group meetings fell off as a result, leading to more cases of delayed or missed payments, not fewer.

Meanwhile, one of the competitive strengths of microfinance organisations is their low cost, well trained and often highly motivated staff. Thus, one would not expect significant cost savings from transferring the current functions of loan agents to (presumably less well trained) agents. One case where this has been tried within an export cash crop system in Africa is the Dunavant "distributor" scheme in Zambia (Tschirley et al. 2004). In this case, extension agents from the main cotton company in the country were laid off and re-contracted as independent agents, whose job was both to provide basic technical support to the company's contract farmers and to on-lend seasonal finance to them. The "distributors" were, therefore, to use their knowledge of cotton farmers in their area to decide who could be trusted to take and receive credit and were paid commissions based both on the volume of seed cotton that their farmers produced and on the credit recovery achieved on the loans. The scheme has reached large numbers of farmers (perhaps up to 2000 distributors serving an average of 60 or so farmers each in some years). Loan repayment rates in excess of 90% are claimed (Tschirley et al. 2004) although probably not up to the 95-98% that microfinance organisations would like to achieve.

A third "technology"[13] designed specifically with rural lending in mind is the use of group contact persons instead of the loan agent meeting directly with each individual borrower during the process of loan administration. This is a direct response to the challenge posed by small loan sizes, especially in rural Africa, and the logic is simple: if a contact person chosen from within a borrower group can assume some of the functions of screening loan requests and collecting loan repayments, then the number of people whom the loan officer needs to meet with in order to achieve and maintain a loan portfolio of a given size is dramatically reduced. For example, if the average size of loan per borrower is US$100 and a loan officer needs to handle a portfolio of US$100,000 in order to recoup her operational costs, then she has to visit 1000 borrowers on a regular basis, which is unlikely to be feasible. However, if these borrowers are organised into groups of five and the loan officer only needs to meet with the contact person from each group, that reduces the number of regular contacts to a more manageable 200.

The key issue with this system is whether a sufficient number of sufficiently strong groups can be formed within a given geographical area for a loans officer to meet only with contact persons without sacrificing loan repayment rates. To our knowledge, there is little empirical evidence on this yet.

Finally, bibliometric information (which can be incorporated into smart cards) may also be used within existing lending programmes to enhance the quality of records regarding borrower repayment rates. Thus, researchers are exploring whether bibliometric information can be used to develop an electronic database of loan repayment performance (the basis for a credit bureau) to reduce screening costs and lending risks for rural lenders in Malawi[14].

Our cautiously advanced assessment at the end of this section is that use of new technologies such as mobile phones, contact persons and smart cards may gradually become more

**Table 7. Rural MFI Illustrative Costs (with Motorbike)**

| Item | Rate | Value | Comments |
|---|---|---|---|
| Number of borrowers | 300 | | High for a single loans officer |
| Loan Portfolio | US$250 per loan | 75000 | |
| Salary | US$300 p.m. | 3600 | |
| Cost of capital | 10% | 7500 | |
| O/H Contribution | | 2000 | |
| Fuel | | 528 | 40km per day for 10 months @ 50 km /litre and US$1.5 per litre |
| Motorbike depreciation | | 300 | Cost US$1500; flat rate depreciationover 5 years |
| Default rate | 5% | 3750 | |
| Total | | 17678 | |
| | | | |
| Interest received | 20% | 14250 | |
| | | | |
| Profit (US$) | | -3428 | |
| Profit per borrower (US$) | | -11.43 | |

common within rural lending in Africa. However, even if they do eventually permit major cost reductions in rural lending, a period of (risky) experimentation will be required first. Hence, our earlier conclusion that, left entirely to market forces, progress in seasonal credit provision for smallholder agriculture is likely to be slow, remains valid.

### 6.2.3. A Hypothetical Cost Model

Table 7 draws on the formula presented in Box 3 to illustrate the economics of lending to smallholder producers in Africa. These costs are not based on any particular lending organisation, although they are believed to be reasonable ball-park figures based on the author's experience and parameters gleaned from literature[15].

It is assumed that the loans officer requires a motorbike, rather than the cheaper bicycle, in order to service his/her loan portfolio. If we assume a population density of 200 persons per km2 – well above the average even for countries such as Malawi and Uganda, but below the current "frontier" identified by Johnson et al. 2004 – along with an average of five persons per household and that only the top quartile of households are able to make good use of loans for agricultural intensification under current conditions, then a loans officer would have to cover an area well in excess of 30km2 in order to find 300 borrowers[16].

Perhaps the most striking feature of the table is that, even with an average loan size of US$250 and a high number of borrowers serviced by a single loans officer (assuming no contact person model), the lending operation makes a loss at

a 20% interest rate[17]. The break-even interest rate is, in fact, around 25%. This suggests a number of options:

- The lender could experiment with a contact person model to increase the number of borrowers serviced by a single loans officer. In fact, if world fertiliser prices come back down to mid-2007 levels, such that an average loan size of US$100-120 becomes adequate for the fertiliser needs of most "large" African smallholders, this may be essential.
- The interest rate could be raised to 25% (or higher). This is discussed below.
- Some form of subsidy could be provided to the lending operation. This is also discussed further below. Here we note that, although the loss per borrower (US$11.43) is quite large at a 20% interest rate, it is much cheaper than the cost of subsidising the same volume of fertiliser to make it affordable to cash-constrained producers[18].

### 6.2.4. Interest Rates

Table 7 focuses attention on the appropriate interest rate to charge smallholders for credit designed to assist them to intensify their agricultural production activities. The first question is whether the rate should be subsidized or not. A supplementary question is, then: if it is to be subsidized how, by how much?

The argument for subsidization is that a very high rate of interest will make the adoption of new agricultural technologies unprofitable and hence unattractive. Whilst the demand of poor households for consumption credit is typically quite inelastic with respect to interest rate and whilst micro-enterprises with high rates of turnover of capital (e.g. petty trading) may support repayment of high interest rate loans, this is not the case with longer-term (seasonal) loans. Adding high interest rates onto high fertilizer prices makes it less likely that the food system will be able to negotiate its critical tightrope between farmer incentives on the one hand and the needs of poor consumers for cheap food on the other (section 6.1).

If interest rate subsidies are accepted as desirable, however, there is a question as to how far they should go. Why should farmers pay 20%, as opposed to 10%, for example? The state-supported and subsidised agricultural credit programmes of the 1970s illustrate the pitfalls with very low rates. The further the interest rate is subsidized, the more expensive it becomes to maintain the subsidy. Thus, credit rationing quickly becomes a feature of the system and the people who end up capturing the majority of the subsidies are the powerful and well connected (typically not smallholders at all under the discredited "old credit policy" programmes).

Instead, Morduch 2005 argues that a subsidy should cover the incremental (transaction) costs of servicing poorer and less accessible borrowers, so that the rate that they pay is comparable to that paid by existing clients. Then, as they build up their asset base and a combination of public investment and increased economic activity makes them more accessible to financial institutions, they are already accustomed to paying "sustainable" long-term interest rates. For micro-finance organizations, this is likely to be in the range 20-25%. Thus, Gobezie 2008 cites Mohamed Yunus as claiming that a "fair" interest rate for poor borrowers should not exceed cost of capital (which itself could be around 10% p.a.) plus 10-15%. The other side of the coin here is that few, if any, organizations serving poor clients can cover their costs if their interest rate is less than cost of capital plus 10%[19].

### 6.2.5. Risk management

So far, we have focused on one of the three main constraints to seasonal lending to smallholder producers in Africa: namely the high costs of disbursing small loans to poor, dispersed rural borrowers. Tackling the second main constraint

- that conventional microfinance models are ill-suited to servicing seasonal agriculture – may require innovative lending models that provide more appropriate incentives to borrowers, especially in bad years. We do not know of any proven models of this nature, but a hypothetical example is provided in Annex 2. For now, we note that the default rate of 5% used in Table 7 assumes that the problem of strategic default can be overcome. We believe that this is possible through a combination of:

- The engagement of experienced lending organizations in rural lending - bringing with them best practice in borrower screening, training and monitoring;
- Innovative repayment incentive schemes, along the lines of that proposed in Annex2.

Nevertheless, even with innovative repayment incentive schemes, repayment rates for seasonal credit are likely to fall substantially in bad years in most African contexts. In other words, Table 7 presents a "normal year" scenario. Even if new lending technologies – such as use of contact persons and novel applications of mobile telephony - can be developed to make such lending profitable in this "normal year" scenario, lenders could still be discouraged from investing in seasonal lending by the prospect of large losses when harvests fail.

Therefore, any effort to promote seasonal lending will have to include an insurance mechanism to compensate for bad year losses. Fortunately, if AGRA supports seasonal lending programmes across a number of African countries within different agro-ecological zones, it should be well placed to broker insurance provision for its participating schemes. Local weather indices are the least cost way of determining when pay-outs should occur, even if this means that the insurance could not cover idiosyncratic losses[20]. If, for example, adverse weather events occurred on average once every five years and borrowers received a pay-out equivalent to 20% of their loan value in such years, the insurance cover would add 4-5% onto their loan interest rate. However, it would mitigate some of the risks of both borrowing and lending for agricultural intensification, reinforce mechanisms such as that set out in Annex 2 and, therefore, greatly enhance the chances that seasonal lending programmes could survive climatic fluctuations.

### 6.3. Member-managed Models

So far we have assumed that the most promising models for seasonal lending involve a large role for a lending officer employed by a microfinance organization, in identifying potential borrowers and collecting repayment from them. The one exception has been discussion of the contact person model, where some of these functions are (partially) transferred to a contact person selected from amongst borrower group members. In fact, this model is a half-way house towards an alternative approach to rural finance, which is based on member-managed groups. Examples include so-called improved ASCAs, cooperative savings and credit organizations (SACCOs) and the village banks supported by FINCA (see Table 6). These groups typically require some external facilitation and training input at the early stages of their development, and may well continue to benefit from some external oversight or periodic access to external technical advice. However, unlike in the microfinance organization model, the aim is for members to be equipped to take on the majority of decision making and record keeping responsibilities associated with basic rural finance functions. As the names suggest, these groups typically have a strong emphasis on savings, but they do also provide loans to members (either entirely out of funds mobilized or partly from matching funds from external sources). From a lending perspective, their big advantage is that they can be lower cost than traditional microfinance models, because many of the

management costs ("a" in the formula in Box 3 and a large part of the costs shown in Table 7) are borne either by the borrowers themselves or by selected members of the borrower community, who have better local information and lower remuneration requirements than employees hired from the wider labour market. This means that they are well placed to handle the small loan sizes required by smallholder agricultural producers.

However, from the perspective of a programme looking to stimulate lending to support agricultural intensification, these member-based approaches have two main limitations. The first is that lending tends to be short-term (one-four months), with little seasonal lending. This keeps lending risks at acceptable levels, given the modest financial management skills of members and local managers, and the fact that it is the savings of poor community members that are being lent out. Short-term lending typically focuses on non-farm micro-enterprises or on consumption credit, with short loan maturities giving plenty of members the chance to borrow in a context where capital can still be scare[21]. The second limitation – in some ways, the other side of the coin from the first – is that more challenging financial transactions, such as seasonal loans, make heavy demands on group governance. Even where success is achieved in one place, therefore, replicability may prove elusive (Johnson et al. 2004). As with all collective action, there are limits to how far and how fast you can scale up success, as so much depends on the dynamics of the groups concerned.

### 6.4. Potential AGRA action: Challenge Funds (Public-Private Partnership) for Expanding Access to Seasonal Credit

Our central proposal in this section is for public private partnerships, achieved through the establishment of dedicated challenge funds, to support seasonal credit provision for agricultural intensification. Under this proposal, the state (e.g. Ministry of Finance) in collaboration with AGRA will make available funds that innovative financial service providers can draw on to subsidise the cost of new and/or expanded seasonal lending operations. Each fund will invite bids from service providers, which will offer to provide seasonal loans to X thousand rural clients with Y wealth distribution (using standard monitoring criteria within the international microfinance industry) in a specified area in exchange for a subsidy of $Z p.a. The resulting service delivery contracts for the successful applicants would be for a specified period (for example, five years), with greater chance of a follow-up application succeeding if the previous targets were met or exceeded. Such funds should, therefore, satisfy the criteria laid down by Morduch 2005 that subsidies for expanding coverage of microfinance services to poor clients should be transparent, rule-bound and time-bound, so as to be compatible with hard enterprise budget constraints, a clear bottom line and competitive pressure.

The most likely applicants to these challenge funds would be microfinance organizations, the types of member-based organisations just discussed and/or organizations supporting them. An existing track record of financial service provision should be one of the requirements for a successful bid. However, bids could come from consortia, not just from individual organizations, and one aim of such challenge funds would be to stimulate innovative partnerships (for example, between financial organisations and mobile phone companies) to pilot new ways of delivering seasonal loan products to African smallholders.

How the subsidy is envisaged and used by the applicants should not be too closely specified. For example, it could be requested as:

- an annual subsidy to cover a deficit such as that illustrated in Table 7

- an annual subsidy to meet the cost of insurance cover for bad years (see section 6.2.5)
- a share of the running costs of an organization dedicated to developing and training sustainable, member-based financial organisations
- a lump sum to cover the costs of introducing a new technology (e.g. smart cards).

Instead, the emphasis would be on assessing outcomes (in terms of expanded access to seasonal lending by previously excluded smallholder groups) against the level of subsidy received. Thus, the challenge fund should also commission independent monitoring of the performance of grantees.

Clearly, the governance of such funds will be critical to their success. Depending on the country, one may envisage a degree of wariness amongst private sector players as to how impartially a state-dominated fund would assess bids and allocate subsidy grants. The participation of an AGRA representative, plus other independent members, on the decision making panel could serve to alleviate some of these fears.

Further thought will also need to be given as to the detailed guidelines for assessing and comparing bids. As already noted, the basic criterion is how many previously excluded smallholders can gain access to seasonal lending for how much subsidy. However, as will have become apparent through previous sections,

**Table 8. Who Is Affected by Food Price Instability and How?**

| Affected Group | Significance (in Africa) | Problem | Inter- or Intra-SeasonalVariability the BiggerIssue? |
|---|---|---|---|
| 1. Poor Consumers | Majority of both rural and urban population; includes nearly all poor households | High prices reduce real incomes, especially in years of low harvest | Peaks in both |
| 2. Net Deficit Producers | 70-80% of rural households | As in 1 but high prices also discourage investment in high value crops | Peaks in both |
| 3. Net Deficit Sellers | 10-15% of rural households, including some of the poorest | As in 2 but also low price immediately after harvest reduces real income | Intra-seasonal troughs |
| 4. Surplus Producers | 20-30% of rural households; often non-poor, but important to food security of poor | Price collapse at bumper harvest and (to a lesser extent) low price immediately after harvest reduce real incomes and depress incentives for investment in intensification | Troughs in both,particularly inter-seasonal troughs |

**Source:** Poulton et al. 2006; note that the first three groups are nested within each other.

the costs of servicing smallholders will depend heavily on factors such as population density of the district concerned, whether or not there are irrigation schemes in the area etc. Thus, these variables will also have to be considered when bids are compared.

One fear surrounding subsidies is that they could distort competition in rural financial markets (see, for example, Gobezie 2008). The proposal presented here is predicated on the observation that there is little seasonal credit provision in most of Africa so far, so subsidies should not end up privileging one existing player over another. However, subsidies may allow successful bidders to gain first mover advantages in particular markets, assisting them to cover start-up costs, establish their brand name and obtain valuable information on (potential) local borrowers. They may also use the period of subsidy to launch complementary services that help to cover organizational overheads in future. To minimize the longer-term consequences for competition, funds could in some cases consider supporting two (or more) players in a given area. In turn, this might require that coverage is rolled out region by region, rather than nationally from the outset. There might also be a requirement on all successful bidders to provide information on borrower repayment performance to a national credit bureau (possibly established specially), so that markets would remain as contestable as possible in subsequent rounds.

## 7. Price stabilisation

Price stabilisation was a central part of the policy set that encouraged the Green Revolution transformation of agricultural, and especially staple food, production in Asia (Dorward et al. 2004; Cummings et al. 2006). It is important not only to get mean food price levels right to encourage agricultural transformation in a low income economy; wide fluctuations around the mean can also have damaging effects on investment. Table 8 distinguishes four groups of households that are affected by crop and food price instability. Whilst politicians are often concerned primarily with impacts of food price instability on the urban poor on their doorsteps, we focus here on the impacts of food price instability on producers of staple foods whom AGRA is seeking to support through its other activities.

We highlight three principal effects. Firstly, (potential) surplus food producers are discouraged from intensifying production if they fear that increased output could lead to price collapse at harvest time, robbing them of any gains from productivity enhancement and possibly even making them worse off overall. (This happened, for example, in Ethiopia in 2001-02). Inter-seasonal price troughs in years of particular abundance are the main concern here, as surplus producers generally have the resources to be able to hold back at least a proportion of their harvest, so as to avoid the worst effects of "normal" intra-seasonal price falls immediately after harvest. If AGRA's agenda to stimulate staple food production throughout Africa is successful, however, we note that (ceteris paribus) the chances of large price falls in good years will increase, as more countries achieve or exceed self-sufficiency in staple food production. This highlights the importance of considering measures to stabilize prices in tandem with measures to raise production.

Secondly (and in partial contrast to the first effect), a non-negligible proportion of producers - including some of the poorest - are unable to protect themselves against even "normal" intra-seasonal price falls immediately after harvest. These households are constrained by cash shortage to act in a way that they know is sub-optimal, i.e. to sell when prices are lowest, and as a result are trapped in poverty through lowered returns on one of their most important activities. If AGRA support enables such households to produce more, in the absence of price stabilisation measures the value of the gains

could be greatly reduced by early sales to acquire cash, whilst enhanced production may even make the "normal" intra-seasonal price falls immediately after harvest worse.

The third effect impacts the largest group of households: all net deficit producers. In many cases, such households have no comparative advantage in producing staple foods (von Braun and Kennedy 1994). However, they continue to devote a large proportion of their land and labour resources to staple food production – rather than diversifying into higher value crops or even non-farm activities – because food markets are either too risky (Fafchamps 1992) or too expensive (Jayne 1994) to rely upon for their staple diets. Whilst food prices spike at (ir) regular intervals, such households will continue to prioritise resources to their own staple food production, unresponsive to initiatives that encourage them to participate in higher value activities. AGRA can and should support these households in two ways:

- Supporting input subsidies programmes that benefit them both directly and indirectly: directly by helping them to intensify their staple food production through, so that they can meet their food needs on a smaller proportion of their available land (or meet more of their needs from the land that they do plant to food staples); indirectly by reducing food prices and raising rural wages;
- Promoting measures that reduce food price volatility, so that households in low potential areas for staple food production feel confident to transfer resources to alternative activities.

### 7.1. Sources of Food Price Instability

Byerlee et al. 2006 note that food price instability is a particular problem in countries where food consumption is dominated by a single major staple, for example rice in much of Asia and Madagascar, wheat in Pakistan and MENA, white maize in eastern and southern Africa, and millet/sorghum in the Sahel. Across such countries they distinguish two principal sources of food price instability:

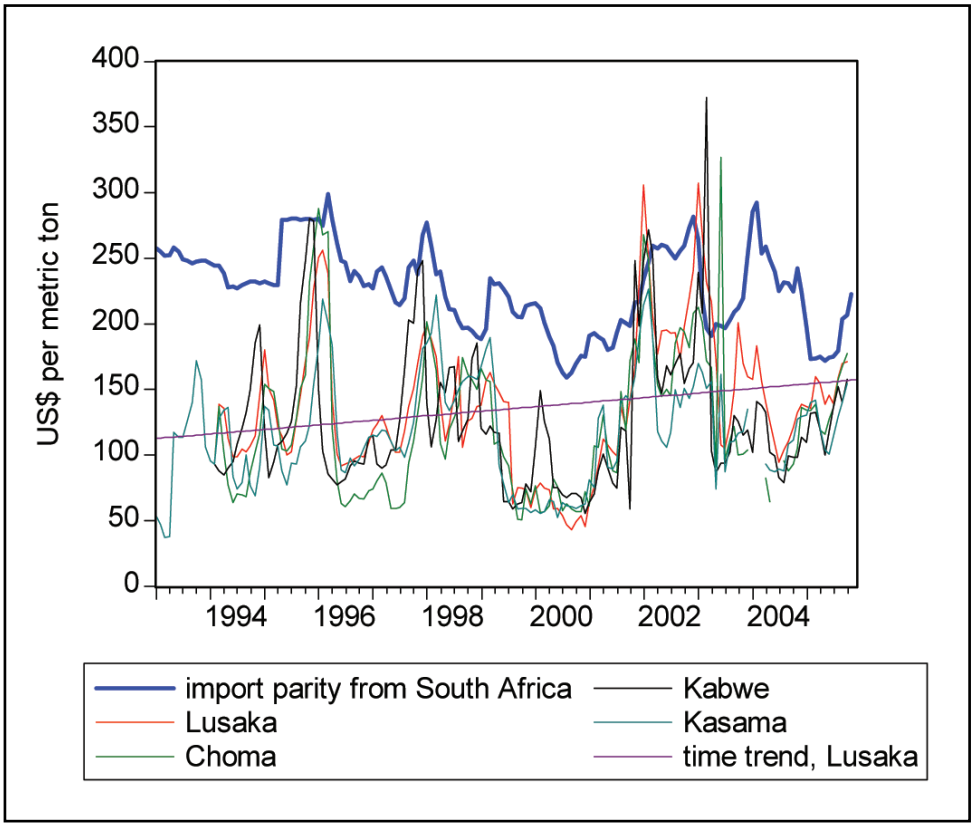
- The international market: this is notably the case for today's low income rice and wheat importers (e.g. Madagascar, Bangladesh, Yemen). In the 1960s and 1970s it was true for much of Asia, as is explained compellingly by Cummings et al. 2006.
- The domestic market (due to weather-induced harvest fluctuations): this is notably the case for eastern and southern Africa, Ethiopia and the Sahel. These countries are generally landlocked, and the high transport costs to and from the coast create a large price band within which food prices can fluctuate in response to variations in the domestic harvest.

The current food crisis only partially fits within this categorization. The enormous rise in global rice prices has particularly affected the first group, but also provoked protests in coastal cities in other countries (e.g. in West Africa) where staple consumption at national level is more diversified. Meanwhile, the large rise in maize prices (albeit considerably less acute than the increase in rice prices) means that even maize importing coastal countries may be considered to be seriously affected[22]. Furthermore, the rise is such that world prices are influencing prices in inland markets that are normally insulated from world price changes. Thus, in Malawi maize prices are currently approaching levels normally associated with import parity even though the harvest has started to come in and the operation of the fertilizer subsidy means that the harvest should be a good one.

Emergency measures, including social protection schemes to support food access by poor households plus food aid where it is available, are needed within many African countries to deal with current food prices. In the medium

**Figure 6. Wholesale maize prices, Zambia, and import parity levels from South Africa**

Source: Reproduced from Jayne et al. 2006, p330-331




term, the only way for regions of Africa to (partially) protect themselves against future international price spikes is to ensure that they are self-sufficient or surplus in key staple foods at regional level. Fertiliser subsidies are likely to be an important tool for achieving this. In what follows, we focus on policies to manage price fluctuations around a mean price that is considerably lower than prices currently prevailing and that is compatible with reliable food access by low income consumers.

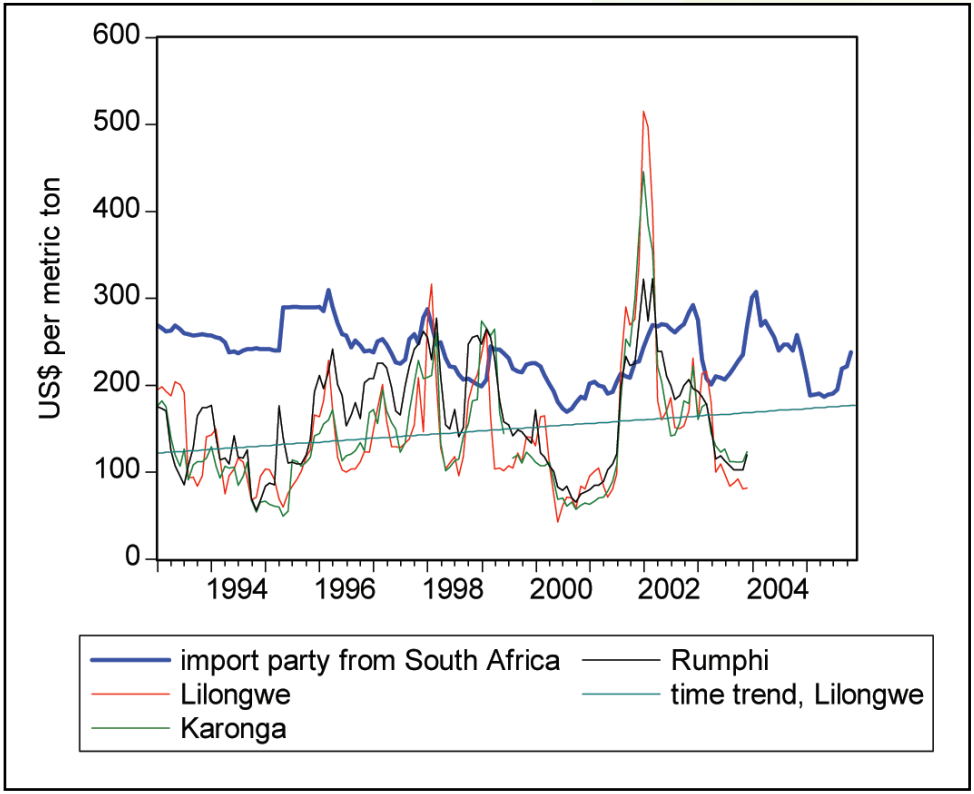
### 7.2. Promoting Cross-Border Trade

As observed by Byerlee et al. 2006, there is widespread agreement on the problem of food price instability, but much less on what to do about it. However, there are some basics on which many observers do agree.

Ultimately, a major aim is to make markets work more efficiently, so that price fluctuations are dampened by private investment in temporal and spatial arbitrage. One important requirement, therefore, is the removal of policy disincentives to private investments in grain storage and transportation. The chief of these

**Figure 7. Retail maize prices, Malawi, and import parity levels from South Africa**

Source: Reproduced from Jayne et al. 2006, p330-331




disincentives is unpredictable interventions in food markets by governments and politicians, for example export bans, waivers on import tariffs for favoured players or politically-motivated distributions of cheap food from food aid consignments or state-controlled storage.

Figures 6 and 7, reproduced from Jayne et al. 2006, illustrate the harm done by ill-considered, poorly administered or ad hoc interventions. In both Zambia and Malawi, during the 1993-2005 period, large fluctuations are observed in domestic maize prices and also in the import parity price (as the cost of maize sourced from South Africa depends inter alia on the size of the local harvest in South Africa[23]). As already discussed, considerable fluctuation in domestic prices is possible due to the large wedge between import and export parity price (the latter unfortunately not shown in the figures). However, the most striking feature of these figures is that, in the years of the poorest domestic harvests, prices did not hit a ceiling at import parity, which they should have done had private markets been encouraged to function efficiently. Instead, mistrust between politicians and private traders meant that collectively the state and the private sector did not import sufficient maize to meet shortfalls. As a result,

prices burst through the import parity price "ceiling" before imports (sometimes combined with food aid) eventually brought them down again.

At the other end of the price range, the lows in Figures 6 and 7 are likely to be below export parity, because private traders were not free to export maize when there were excess quantities within the domestic market. Whilst the extreme high prices are disastrous for poor consumers, the extreme low prices serve to discourage producers from intensifying their maize production.

These problems of state interference in regional trade are particularly severe in southern and eastern Africa, so we concentrate on these regions in the remainder of this section[24].

For political reasons, if not also for economic ones, politicians are likely to continue to engage actively with staple food markets, given the importance of staple foods in the consumption baskets of their electorates (Dana et al. 2006; Poulton et al. 2006). According to Poulton et al. 2006 (p347), therefore, the challenge is to manage state intervention such that:

- Politicians can be "seen to be doing something";
- The intervention actually makes matters better, not worse;
- It supports a dominant role for private storage activity, rather than undermining it;
- It is compatible with free import and export of food;
- It generates clear guidelines for the consistent management of food aid.

Encouraging free (i.e. not subject to administrative restriction) trade in food within southern and eastern Africa should be a major objective for AGRA. As will be shown, this will not solve all the price stabilization challenges of the regions. However, it should avoid future episodes (such as those shown in Figures 6 and 7) where maize prices exceed import parity price or fall below export parity price. It would thereby remove the worst price volatility, even if policy might legitimately seek to go beyond this and further narrow the band within which food prices fluctuate.

If encouraging free trade in food within southern and eastern Africa sounds a modest objective, it should be noted that the regional trading blocs SADC and COMESA have existed for many years, yet have made little progress towards this objective. Why, therefore, do governments intervene in food markets unpredictable ways?

In the case of import tariff waivers (normally for well-connected traders), the most persuasive explanation is rent-seeking. In the case of export bans, however, those responsible may have more legitimate concerns. Fundamentally, if governments have limited confidence that they can buy in maize from neighbouring countries when they are in need, they will be reluctant to let any surpluses that they do have flow out of their borders[25] – even though this reinforces the basic problem.

In turn, these fears can be attributed to at least two factors. Firstly, historic production patterns indicate that there are crisis years, particularly in southern Africa, when regional trade will not be adequate to compensate for domestic production shortfalls. As is well known, harvests within African regions exhibit a degree of correlation due to covariance in weather events (see Table A3.2 for data for 1981-2005). Examples of correlation include Zimbabwe, South Africa and Zambia on the one hand and Uganda, Tanzania, Malawi and Mozambique on the other. By contrast, harvests across southern Africa on the one hand and eastern Africa on the other are rarely positively correlated. Unfortunately, neither are they negatively correlated, which would be ideal for price stabilization through trade. In three of the four worst drought years of the 1981-2005 period in southern Africa (1984, 1992 and 1995), the total harvest in

eastern Africa was also below its long-term trend level, meaning that there was little surplus to sell southwards. Finally, as already observed, production variability is much greater within southern Africa than eastern Africa. Thus, the largest shortfalls in southern Africa greatly exceed the largest surpluses within eastern Africa.

The second factor, which exacerbates this, is that southern and eastern Africa have moved progressively from maize self-sufficient or surplus towards maize deficit over the past decade or so (Jayne et al. 2006)[26]. Thus, maize is seen as an increasingly scarce commodity in the region as a whole.

What, therefore, is required to reassure governments that they can safely commit to respecting free cross-border trade in staple foods (good for price stability and also for the development of private sector trading and storage operations)? We suggest that the following is needed:

- An increase in production within southern and eastern Africa, such that maize is not perceived as a scarce commodity. AGRA-supported subsidies can help here.
- A coordinated move, probably requiring some degree of external facilitation, such that several countries commit together to freer trade[27].
- Provisions for dealing with production fluctuations that exceed the capacity of cross-border trading to handle, most notably the worst drought years in southern Africa.

### 7.2.1. Securing Supplies and Stabilising Prices in Drought Years

If cereals production in southern and eastern Africa increases sufficiently, as a result of fertilizer subsidies and other interventions, one could conceivably store grain to cover even the worst drought years. However, this would be very expensive due to both the (in)frequency and the severity of such events. In 1992 southern African grain production was 60% below the mean level for the 1981-2005 period as a whole; in 1983, 1984 and 1995 it was more than 30% below. Huge quantities would have to be stored to cope with such shocks. Shocks of this magnitude come once every five years or so, which means that, on average, grain stocks would have to be stored for 2.5 years in anticipation of a major drought. This lengthy period again makes storage an expensive option. Moreover, major droughts are not necessarily preceded and followed by bumper harvests. Instead, harvests may fall below long-term average levels for two or more years (1982-84 and 1990-92 in southern Africa; 1989-90, 1992-95 and 1998-2000 in eastern Africa). This makes it even more difficult to protect against shortfalls entirely on the basis of storage.

{Poulton, 2006 #104} suggest that dedicated emergency funds could be set aside to pay for the cost of importing grain during major droughts. They suggest that this could be more cost effective than storage, especially for coastal countries. However, a better option still is weather-indexed insurance, now being used by Malawi with the assistance of the World Bank[28]. This generates a payout when rainfall at designated stations falls below specified levels, with the size of the payout determined by a model that links maize production to rainfall. In the case of storage, stocks, once exhausted, are exhausted – even if a second drought quickly follows the first. A major advantage of insurance is that the risks of two bad years following in quick succession are borne by the insurance company, not the local population.

As the Malawi case shows, the insurance approach can be implemented by individual countries. However, particularly in the context of moves towards freer intra-regional trade, there could be benefits to exploring regional variants. The first of these is that, if harvests are imperfectly correlated within a region (see Table A3.2) and grain is free to move across borders,

then the risk of a major weather event affecting an entire region with a given intensity is lower than the risk of it affecting all the constitutent countries independently with the same intensity. Thus, overall premia should be lower. The other side of this same coin is that, if one country receives an insurance payout, but is committed to a regional free trade agreement, some of the benefits from that payout may leak out across its borders.

Of course, a regional arrangement adds complexity and there would be costs to negotiating the rules of operation – firstly between the insurer and the group of countries, regarding how the payout would be triggered, and secondly amongst the group of countries, regarding how contributions to premia would be divided up and how any payouts would be distributed across the countries. It is, however, possible to conceive of rules, based on objective rainfall measurements, to solve these problems.

AGRA could assist countries interested in such options to work through these issues, possibly in collaboration with the World Bank, but most importantly as part of a coherent strategy to promote more stable food prices and greater intra-regional trade.

### 7.2.2. A Role for Storage?

Ultimately, one of the objectives of greater cross-border trade in grains is to create an environment in which private traders will invest in storage capacity. However, this investment response will not happen overnight. One can well imagine some traders wishing to see whether rules on cross-border trade are observed in practice – including in drought and election years – before committing themselves to major storage investments. For their part, governments are unlikely to suddenly put themselves in a position of total dependence on the private sector for such a key part of national food security, given the history of mistrust between public and private sectors in many African countries.

For these reasons, some public sector storage activity is likely to continue even as moves are taken towards greater regional trade and private sector activity. The question then is how this is managed, as unpredictable storage and release decisions by public sector agencies are often cited as a major disincentive to private sector investment ({Coulter, 2002 #109}). Poulton et al. 2006 discuss approaches to national-level state grain storage, that seek to build predictability into public sector storage activities, but acknowledge that holding some stocks at supra-national could have advantages. AGRA could try to mobilise the political will to establish regional grain stores of this nature.

Whilst not designed to cope with major droughts, regional grain store(s) could provide some assurance that grain would be available within the region, especially in times of shortage, hence giving politicians the confidence to let grain be exported across their borders at times of surplus. Available grain could be used to ease temporary price surges in national markets (avoiding surges all the way up to international import parity price), whilst the process of replenishing the stock should also provide an additional mechanism for supporting post-harvest producer prices in times of plenty.

The main advantage of a supra-national approach to storage is that it would have to be rule-based for individual countries to agree to it in the first place. Then, once rules were put in place, this would make for a much more predictable environment for private grain storage activity than past ad hoc interventions, especially if all withdrawals from the stock were formally announced. Moreover, once several countries had agreed to a set of rules, each would have an interest in ensuring that the others kept to those rules, which should enhance credibility[29].

Rules are, therefore, key to the successful management of a regional storage facility. Critical elements to be worked out include:

- Which countries participate: as with free trade in grains (footnote 25), willingness is likely to be the main determinant. However, it would also help if harvests were not all correlated, as this would make stock turnover easier and reduce the average cost of storing grain;
- How many stores should there be within the area covered and where should these be situated? More stores mean shorter transport distances (lower costs) and an ability to influence prices over a wider area, but add to managerial requirements. There may also be economies of scale in storage;
- The basic governance mechanism for the storage operation: one possibility would be a board comprising one member from every participating country, plus independent members (including AGRA, if it decided to support the initiative);
- When and how grain is obtained. This should be done according to transparent guidelines, so as to minimize negative impacts on private trading operations. For example, the stores might: 1) seek to buy where the market price is lowest (net of transport costs or not?), so as to fulfil a limited price support function; 2) only buy where the price fell below an agreed and announced price (in US$ terms), this price to be established by members on an annual basis;
- How grain is accessed. Again, the guidelines on which the system operates should be made public. For example: a) a participating government has to make the case that it needs grain from a regional store, based on harvest projections[30], plus expectations of harvest in neighbouring countries; b) the request then has to be approved by Board, where at least some of the other states should have a vested interest in ensuring that the grain is not simply going to be squandered on local political objectives; c) the release price (also established by members on an annual basis?) is set well above the maximum price paid to purchase grain (see above), so as to cover average storage costs and discourage political disbursements of grain obtained from stores[31].

It is difficult to suggest even indicative buying and release prices whilst world commodity prices – and African market responses to them – are still so uncertain. However, if world fertiliser prices do fall back to 2007 levels (see Figure 3), a maximum purchase price of around US$140 per ton and a minimum out-of-store selling price of around US$200 per ton could be sensible. The former would provide producers who had taken credit with some assurance that price was not going to collapse, although it would not guarantee the profitability of fertilizer use, whilst the latter should comfortably cover storage costs, assuming that there is a reasonable turnover of stock, and leave scope for private arbitrage.

Finally, given that a long-term goal is to increase private investment in storage within the southern and eastern African region, we consider how the management of a regional storage facility could encourage, rather than discourage, private storage activity. We observe the following:

- Free trade is a prerequisite for major private investment in storage capacity and activity within southern and eastern Africa. However, major public storage activity could crowd this out – an outcome that policy should look to avoid!
- Our starting assumption is that private storage capacity is limited and – partly for this reason – could be high cost[32]. Therefore, a regional storage facility may need to contract some existing (underutilised) state capacity at the start of its existence;

- However, it should look to contract private storage where possible and look to increase over time the amount of private storage services that it contracts. (This could help reduce the risk to private investors of buying up or building new storage capacity);
- If a warehouse receipt system is in operation, the regional storage facility could instead hold warehouse receipts (for grain in private storage), rather than physical stocks.

As well as supporting initiatives to establish regional grain storage (as always, as part of a wider strategy to stabilize prices within southern and eastern Africa), AGRA may work with concerned parties to promote proper drying and quality control by smallholder maize producers, to ensure that their maize is not rejected by buyers looking to supply the storage facility. This is an area in which Uganda Grain Traders and presumably also World Food Programme have experience.

## 8. Conclusions

Increases in staple food crop productivity have a critical role to play in economic development, poverty reduction and food security in Africa. This requires governments, with private sector actors, farmers and civil society, to address a number of challenges: specific technical constraints to productivity increases; lack of important public goods (principally infrastructure and institutions); recent dramatic increases in food and fertiliser prices; poor policy coordination; lack of complementary coordination in rural service development and provision; low profitability of input use; unaffordability of on-farm productivity investments; and high price instability.

The extent, nature of and solutions to these challenges, and hence the nature and importance of responses to them, vary between high response cereals (maize and rice),low response cereals (sorghum and millet), and roots and tubers (cassava and yams).

Recent international commodity price increases, particularly those affecting food grains and fertilisers, pose severe challenges to increasing staple food production and to rural welfare. In many ways these intensify both the challenges and the importance of governments taking effective and efficient action to address coordination problems faced in staple food crop intensification. An important part of such action should involve governments working with the private sector, farmers and other interested parties through input subsidies, credit programmes and price stabilisation policies where these can address constraints to intensification of staple crop production on smallholder farms.

With its human and financial resources, its relationships with governments and the private sector, and its strategic focus on agriculture, AGRA can play a critical role in supporting regional, national and field level processes that develop and promote new approaches and good practice for governments seeking to increase staple food crop productivity. To this end AGRA should pursue a range of different kinds of approaches operating at different levels in partnerships with different actors. Specific suggestions are made for work with governments and RECs to develop regional policies for price stabilisation, work with financial organisations to develop field systems for seasonal credit services, and work with a range of different stakeholders to develop and test particular innovations for improving the efficiency and effectiveness of input subsidy programmes.

## End Notes

[1] Morris et al. 2007 present data suggesting that maize and rice tend to have higher fertilizer responses than sorghum and millet, but that for all crops the responses are highly variable and sensitive to rainfall, soils, fertilizer application methods and formulations, and complementary soil management practices

[2] Transport and finance charges can be expected to increase in rough proportion to the international price. Recent newspaper reports of urea prices in Malawi are in line with this.

[3] Given limited financial market development (for both credit and insurance), cash constrained poor households may be unable to afford inputs at planting time even if economic analysis shows that use of those inputs would be profitable over the course of the production season.

[4] Note that this assumes that policy is seeking to directly assist poor households. However, poor households may also benefit from market-mediated effects (e.g. lower food prices, higher rural wages) of initiatives designed to stimulate production by the less poor. It is an empirical question which approach generates the greater benefits.

[5] Counter-arguments are that in a predominantly agricultural economy, demand for other services may not be much less seasonal than that for credit (see below). Moreover, risks may be covariant with risks associated with seasonal lending. However, these problems will decrease over time.

[6] Medium-term credit for investments in animal traction equipment, land improvements, processing etc is also largely absent in rural Africa.

[7] Some very poor households never graduate – ongoing subsidy as form of productive welfare for these households?

[8] We focus on staple foods in this paper, but note that policy to stimulate staple food production should simultaneously assist poor households without any comparative advantage in staples production to shift to higher value crops. This will be facilitated both by interventions that enable them to devote less scarce land to staples production and by interventions that lower the level and variability of food prices in local markets.

[9] These figures are for total population, i.e. rural + urban.

[10] Their case studies were undertaken in Kenya, which has a relatively strong and innovative microfinance industry.

[11] This is apparently less of a problem in Ethiopia where rural microfinance has grown rapidly over the past decade (now reaching around 10% of the total population). According to Gobezie 2008, there is a "comparatively good culture of high financial discipline in most Ethiopian cultures".

[12] Money can deposited on the M-Pesa system; it does not all have to be transferred. However, for regulatory reasons Safaricom do not market this facility heavily and Ivatory and Mas 2008 suggest that it not widely used.

[13] Here we use the term "technology" as it is used by some microfinance practitioners to refer to any innovation in product or lending process.

[14] Source: http://www.basis.wisc.edu/projects_ama/Biometrics_Malawi.html. Accessed 16/06/08.

[15] The figures in the table reflect the high cost of fertiliser (hence the US$250 loan size) and also the high current cost of fuel. However, they assume that wages and other costs associated with running a lending operation have not risen in line with these.

[16] The figure of 30km2 is arrived at if the loans officer works with every eligible household, in other words: 1) there is no other provider competing to supply financial services and 2) all households in the area are deemed to be creditworthy (i.e. not just able to take and repay a loan, but likely to do so). Given the current culture of "strategic default" in many places, condition 2) is particularly unlikely to hold. Incidentally, this sort of calculation highlights the benefits of irrigation schemes as a focus for service provision. The high density of potential clients on such schemes means that a single loans officer can disburse large numbers of loans, possibly without even requiring a motorbike.

[17] If this is 20% per season, the "per annum" figure will be higher.

[18] Assuming a 66% subsidy, as in Malawi in the first years of the current subsidy scheme, the cost would be US$165 for fertiliser with a market value of US$250 or US$66 for fertiliser with a market value of US$100. Even in the latter scenario, the cost of subsidising a credit programme to assist larger smallholders access fertiliser is only 1/6 of the cost of subsidising the same fertiliser directly. Note, however, the discussion above about comparability between a fertiliser subsidy and a credit programme.

[19] Gobezie 2008 also discusses the Alliance For Fair Microfinance "parameter" that, "the cost of micro-loan should not exceed a third of the loan amount, of which a third [i.e. maximum 11%] is cost of capital, another third is for operational cost, and the last third is for investments, provisioning and profit". This gives a potentially higher figure than the Yunus rule. Gobezie's own position is to be cautious of any subsidization of interest rates in microfinance. However, this leads him/her to argue that, due to high costs of serving poor clients, interest rates for micro-loans in rural Africa may have to exceed even the Alliance For Fair Microfinance limit of 33%.

[20] The author's experience of agricultural lending in Western Kenya included a case where the crop on one side of a village was wiped out by an untimely hail storm, whilst the other side of the village was unaffected. Unfortunately, requiring loans officers to verify individual claims of damages would be prohibitively expensive.

[21] Improved ASCAs, promoted initially by CARE in Mali, seem to run nicely after an initial training input, but only provide limited funds for seasonal agricultural production. In western Kenya Agmark sought to link an improved ASCA scheme to local input stockists, who held any "excess" savings generated by group members during the period that the ASCA was being built up. When it was eventually distributed back to members (just before the start of the agricultural season) it was natural for the funds to be used to purchase inputs. However, after nine months of regular saving (plus reinvested consumption borrowing out of this), the average sum realized by group members was only sufficient to purchase one bag of fertilizer (or less).

[22] Maize importing coastal countries were not included in Byerlee et al. 2006's categorization of particularly vulnerable countries, because the large volumes of maize traded internationally each year tend to dampen price fluctuations.

[23] Note that in some years Malawi also imports maize from northern Mozambique. The cost of this is considerably less than the cost of maize sourced from South Africa.

[24] In 2000 eight countries of the West African Economic and Monetary Union (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Buissau, Mali, Niger, Senegal and Togo) committed themselves to a customs union, whereby all internal tariffs were removed and replaced by a common external tariff. There remain frictions between countries regarding application of the common external tariff and informal obstacles to the movement of goods (e.g. local roadblocks) remain. However, goods, including staple foodstuffs, can flow fairly smoothly from country to country. The notion of a customs union had been floated within the Francophone West African countries for many years, encouraged by their sharing of a common currency. It received additional impetus following the devaluation of the CFA franc in 1994, a "successful" example of collective action by governments in the region, which also stimulated considerable informal cross-border trade, including in staple foods (Yade et al. 1999) as a by-product. Meanwhile, as further justification for focusing our thinking on eastern and southern Africa, we also note that cereals production fluctuates less in West Africa than in southern or eastern Africa (Annex 3) and that price stabilisation is less of an issue for countries where roots and tubers are important components of the

staples diet, as is the case in several West Africa countries.

[25] This is analogous to the behaviour of poor, net deficit households that prioritise own production of food staples, rather than devoting land and labour to the production of higher value crops, because they are not confident that markets will supply them with food at a price they can afford as and when they need it.

[26] This can be attributed to: 1) South African producers switching out of maize following market liberalisation in the mid-1990s. (They have, however, increased production again recently in response to rising world maize prices); 2) the collapse in maize production in Zimbabwe post-2001; 3) the low or negative growth in per capita staples production in southern and eastern Africa since the 1990s, as investment in agriculture in general has declined.

[27] We do not suggest which countries these should be. The correlation statistics in Table 3.2 provide some guidance as to where benefits might be reaped, bearing in mind also that high transport costs limit the distance over which beneficial arbitrage can take place. However, ultimately the key determinant will be political will.

[28] http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21805053~pagePK:34370~piPK:34424~theSitePK:4607,00.html (accessed 16 June 2008)

[29] There is an analogy here to joint liability amongst credit groups. As Stiglitz 1990 showed, in the presence of covariate risk, the normal incentives could be inverted. Likewise, here, in the event of a major region-wide drought, one would expect the participating countries to empty the store completely. However, it should still be possible to construct rules that mean that this was done by consensus, rather than through a series of uncoordinated actions by member states.

[30] As the experience of the Malawi input subsidy in 2006/07 illustrated (Box 2), there is a keen need for improved estimates of national crop production. We understand that improving the quality of national agricultural statistics is a high priority for the Bill and Melinda Gates Foundation and hope that use of satellite imagery for enhanced crop production estimates will figure within their activities.

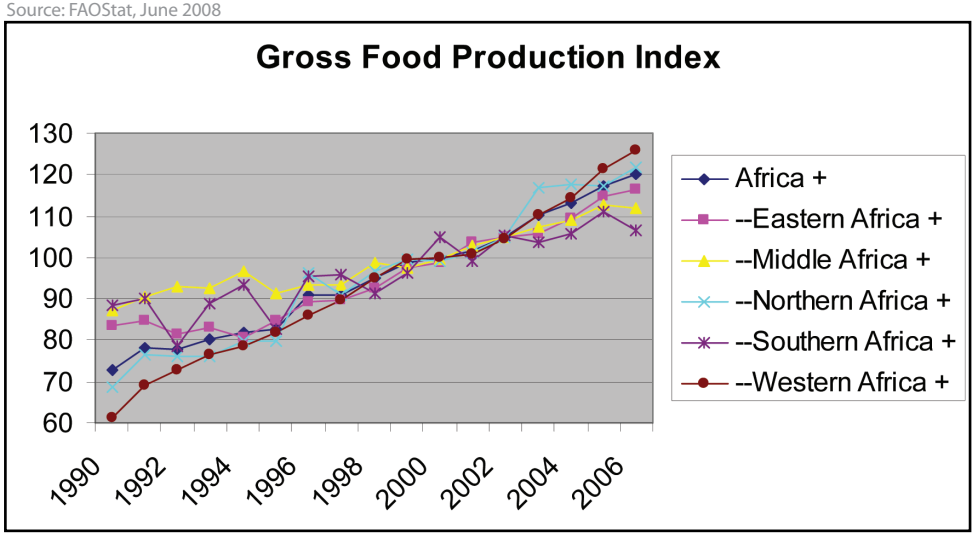
[31] Commitment to free cross-border trade means that grain released cheaply onto a national market is likely to quickly make its way over a border. However, cheap maize would still deliver a rent to the immediate recipients – hence potentially satisfy political objectives – whilst immediate neighbouring countries might not resist too strongly if they expected to be beneficiaries. Hence, the need for a publicly announced release price.

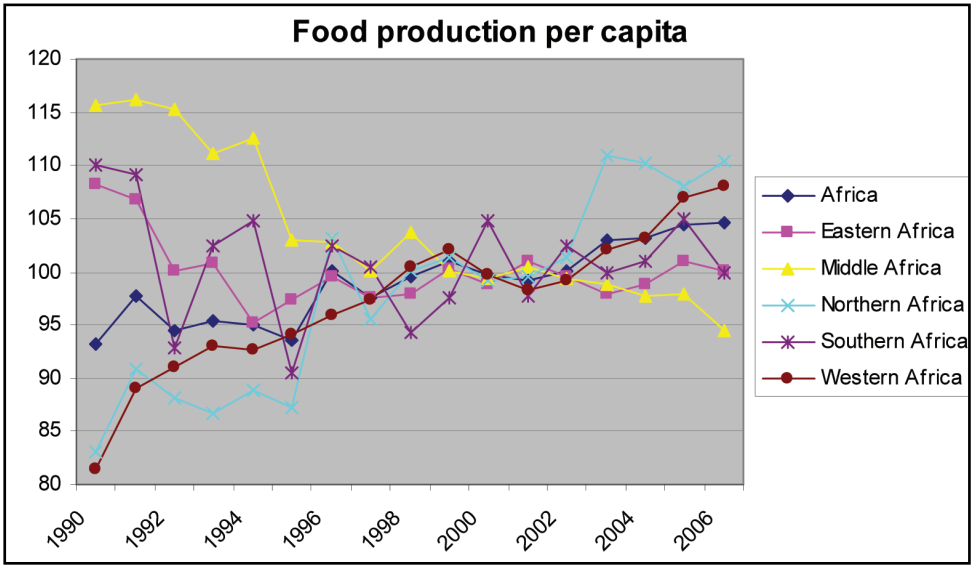
[32] According to Goedike 2004 (quoted in Southern Africa Regional Poverty Network 2004), storage costs in Zimbabwe were double or more those in South Africa, where capacity is greater and the market thus more competitive.

## Annexes

### Annex 1. Food Production Trends in Africa, by Region

Source: FAOStat, June 2008



**Annex 2: Alternative Rules for Group-Based Loan Repayment**

In this annex we present a group-based loan repayment incentive structure that responds both to the problem of inflexible disbursement schedules within seasonal agricultural lending and to the problem of perverse repayment incentives for joint liability groups in bad years under covariant risk (Stiglitz 1990; Besley and Coate 1995)[33]. For existing borrower groups, two criteria are set for access to credit in a new borrowing season:

- The sum that the group as a whole gets access to is dependent on the repayment performance during the previous season. The relationship is set out in Table A2.1. This builds on the observation that access to increased credit volumes is the single greatest incentive for poor borrowers to repay loans (Dorward et al. 2001). It also aims to keep credit repayment, even in a bad year, above 80%, which is the level of repayment claimed by successful cash crop lending schemes, such as that operated by Cottco in Zimbabwe, in drought years.
- An individual member can stay within the scheme only if they repay more than 80% of the outstanding sum owed at the start of season. Debts are rolled over at the prevailing scheme interest rate of 20% p.a.

**Table A2.1. Linking Current Repayment Performance with Future Credit Allocation**

| Repayment Rate in Current Year(s) | Total Credit Allocation in Following Yearcompared with Current Year |
|---|---|
| 99-100% | Double |
| 95-98.9% | + 50% |
| 90-94.9% | Same |
| 80-89.9% | - 25% |
| Below 80% | Excluded |

With regard to disbursement schedules, in conventional (Grameen-style) microenterprise lending, if one group member delays in repaying a loan, other group members have the option of repaying on their behalf or giving them additional time to complete repayment. In the case of agricultural lending, this latter option does not exist, as new loan applications have to be processed by a set deadline in time for the start of the new planting season. In this context, excluding a whole group whilst a single loan remains outstanding is unreasonably rigid. Instead, the "rigidity" of the timing of new disbursements requires some flexibility on the repayment criteria that qualify for future access.

Under the alternative incentive scheme proposed here, after a good year, the group as a whole gets access to an expanded volume of credit for the following year and gets to choose whether to let additional members join the group or whether to increase the sum that each member borrows. If the group takes in additional members, it can grow until it reaches a ceiling of 10 members, at which point it has to split if it wants to include additional family members or neighbours in the credit scheme. Equally importantly, in a bad year, there are still incentives for individual members to repay, if the group as a whole can achieve 80% repayment. These are strengthened if excluded members can "re-enter" at a future date upon repaying their outstanding debt plus interest and at the discretion of the members still "in" (i.e. if the members still in believe that the misfortune experienced in the bad year was genuinely unavoidable, not the result of laziness or a deliberate choice to default). Thus, members who are unable to repay 80% of their outstanding debt still have reason to repay what they can, even in a bad year, so as to help the rest of the group stay in business until such time as they themselves can rejoin.

A simple example of possible dynamics in a bad year is given in Table A2.2 below. In a group of seven borrowers, three are able to repay their loan in full, despite the poor season/year. They have an incentive to do this as long as they can encourage their other group members to repay enough that the group as a whole repays 80% of their outstanding debt. Two other group members are unable to repay their whole loan, but have an incentive to achieve 80% repayment in order to qualify for some new lending the following year. The final two cannot achieve even this, but still have an incentive to repay what they can if:

- This enables the other group members to qualify for loans the following year
- By showing good faith in making what contribution they can, they increase the likelihood that other group members will readmit them to the group once they have repaid their outstanding debt.

**Table A2.2: Example of Group Survival in a Bad Year**

| Member | Borrowed | Repaid | Outcome |
|---|---|---|---|
| 1 | 100 | 100 | In |
| 2 | 100 | 100 | In |
| 3 | 100 | 84 | In; debt of 16 + interest carried forward |
| 4 | 100 | 35 | Out (temporarily?) |
| 5 | 100 | 82 | In; debt of 18 + interest carried forward |
| 6 | 100 | 100 | In |
| 7 | 100 | 52 | Out (temporarily?) |
| Overall | 700 | 563 (80%) | Group continues with members 1,2,3,5,6 borrowing 525 between them |

## Annex 3: Variability in Staple Food Production in West, Eastern and Southern Africa

### 1) Assessing Variability in Total Cereals Production by African Region

Using FAOSTAT data for 1981-2005, total annual cereals production was calculated for the following "regions":

- West: Benin, Burkina Faso, Cameroon, CAR, Chad, DR Congo, Republic of Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Guinea-Buissau, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo
- Eastern: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Sudan, Tanzania, Uganda
- Southern: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe
- Cereals included maize, sorghum, millet, rice, wheat and teff. To compare variability across regions, the following steps were taken:
- Total production in each region was regressed against a time trend variable. Over the period in question, there was strong growth in cereal production in West Africa (a gain of over a million tons per year) and in Eastern Africa (a gain of over just under half a million tons per year), but no significant trend in Southern Africa.
- For each year, the trend rate of production (calculated from the regressions) in West Africa and in Eastern Africa was subtracted from total recorded production in each region. For Southern Africa mean annual production across the whole period was subtracted from the total recorded production each year.
- Standard deviations of the resulting differences were calculated by region. These are shown in Table A3.1. (The mean of the resulting differences was zero in each case).

**Table A3.1. Assessing Variability in Cereals Production by African Region**

| Region | Mean Annual Cereal Production 1981-2005 (tons) (1) | Standard Deviation of Differences from Longterm Production Trend (2) | Variability Indicator (3) = (2) / (1) |
|---|---|---|---|
| West | 34,852,966 | 2,292,687 | 0.066 |
| Eastern | 19,559,571 | 1,665,103 | 0.085 |
| Southern | 18,265,245 | 3,951,625 | 0.216 |

Source: adapted from Poulton et al. 2006; note that the first three groups are nested within each other.

- These standard deviations were then compared against mean production in the region over the period as a whole. Table A3.1 shows that variability around the long-term production trend is much higher in Southern Africa than in Eastern or West Africa.

**2) Correlations in Maize Production in Southern and Eastern Africa**

(See Table A3.2 on the next page)

**Table A3.2. Correlations in Maize Production in Southern and Eastern Africa, 1981-2005 (source: FAOSTAT)**

| | | Tanzania | Angola | Botswana | Lesotho | Malawi | Mozambique | Namibia | Swaziland | Zambia | Zimbabwe | SouthAfrica |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tanzania | Correlation | 1 | .470* | .127 | .069 | .385* | .658** | -.138 | .063 | -.030 | -.261 | .064 |
| | Signif. | | .012 | .519 | .728 | .043 | .000 | .485 | .749 | .880 | .180 | .747 |
| Angola | Correlation | .470* | 1 | -.014 | -.093 | .297 | .808** | .098 | -.230 | -.275 | -.458* | .145 |
| | Signif. | .012 | | .944 | .640 | .125 | .000 | .621 | .238 | .157 | .014 | .461 |
| Botswana | Correlation | .127 | -.014 | 1 | .418* | -.109 | .041 | .425* | -.144 | .265 | .358 | .598** |
| | Signif. | .519 | .944 | | .027 | .579 | .835 | .024 | .464 | .174 | .061 | .001 |
| Lesotho | Correlation | .069 | -.093 | .418* | 1 | .076 | .103 | -.061 | .228 | .342 | .479** | .359 |
| | Signif. | .728 | .640 | .027 | | .702 | .601 | .759 | .243 | .075 | .010 | .061 |
| Malawi | Correlation | .385* | .297 | -.109 | .076 | 1 | .593** | .002 | .084 | .097 | .050 | .107 |
| | Signif. | .043 | .125 | .579 | .702 | | .001 | .993 | .670 | .624 | .799 | .586 |
| Mozambique | Correlation | .658** | .808** | .041 | .103 | .593** | 1 | .140 | -.004 | -.266 | -.250 | .206 |
| | Signif. | .000 | .000 | .835 | .601 | .001 | | .477 | .986 | .172 | .199 | .293 |
| Namibia | Correlation | -.138 | .098 | .425* | -.061 | .002 | .140 | 1 | -.406* | -.071 | .006 | .349 |
| | Signif. | .485 | .621 | .024 | .759 | .993 | .477 | | .032 | .720 | .974 | .068 |
| Swaziland | Correlation | .063 | -.230 | -.144 | .228 | .084 | -.004 | -.406* | 1 | .130 | .394* | -.135 |
| | Signif. | .749 | .238 | .464 | .243 | .670 | .986 | .032 | | .511 | .038 | .492 |
| Zambia | Correlation | -.030 | -.275 | .265 | .342 | .097 | -.266 | -.071 | .130 | 1 | .502** | .326 |
| | Signif. | .880 | .157 | .174 | .075 | .624 | .172 | .720 | .511 | | .006 | .090 |
| Zimbabwe | Correlation | -.261 | -.458* | .358 | .479** | .050 | -.250 | .006 | .394* | .502** | 1 | .502** |
| | Signif. | .180 | .014 | .061 | .010 | .799 | .199 | .974 | .038 | .006 | | .007 |
| SouthAfrica | Correlation | .064 | .145 | .598** | .359 | .107 | .206 | .349 | -.135 | .326 | .502** | 1 |
| | Signif. | .747 | .461 | .001 | .061 | .586 | .293 | .068 | .492 | .090 | .007 | |

** Pearson Correlation is significant at the 0.01 level (2-tailed).
* Pearson Correlation is significant at the 0.05 level (2-tailed).
N=28 in all cases

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