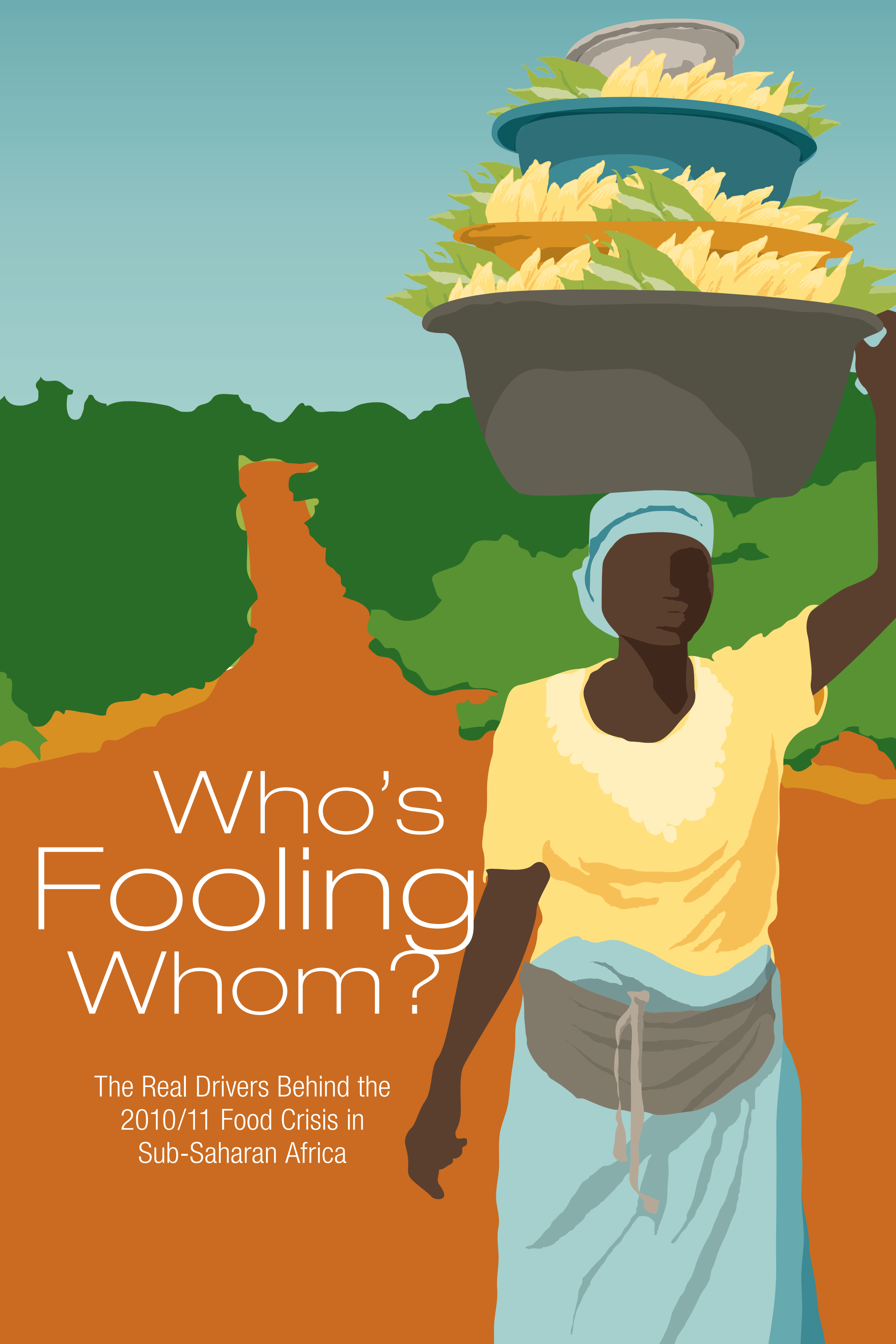

Who's Fooling Whom?

The Real Drivers Behind the 2010/11 Food Crisis in Sub-Saharan Africa

Executive Summary

In October 2012, PANGEA released the first edition of its report *Who's Fooling Whom* that looked at price transmission from spiking food prices in the international markets to African food markets. The analysis in the paper uses 269 price series of six staple crops – i.e. cassava, maize, millet, rice, sorghum[1] and wheat – per tonne from local markets in 20 Sub-Saharan African countries[2], compiled by FAO (2012) and already converted in US dollars.

The six staple crops examined here have been selected both on the basis of their international price dynamics – especially maize, rice and wheat, and because four of them (cassava, maize, millet and sorghum) are some of the most promising for the production of biofuels in Africa (Aidenvironment 2008).

Local prices are compared to international prices of maize, rice, sorghum and wheat drawn from the FAO's Trade and Markets Division's database over the period starting in June 2010, when global prices dipped, and ending on the month when they peaked – i.e. maize: April 2011, rice: November 2011, sorghum: August 2011, wheat: May 2011. Cassava and millet are not traded on international exchanges and their price dynamics followed different trends than the other crops, hence are analysed individually[3].

1 Grain sorghum.

2 Burkina Faso, Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe.

3 As price dynamics for cassava and millet differ widely across countries, the analysis takes into account the highest percentage increase over the period considered in each country.

The analysis conducted makes it possible to draw important conclusions from the factors behind the high food prices in Sub-Saharan Africa in 2010/11. First of all, the degree of price transmission from international to local markets has been quite limited: price increases in the countries examined were on average lower than the relative rises in global food prices. It is demonstrated by the overwhelming trend among price points in the 20 African countries that when prices soared internationally, price increases were tempered significantly.

In fact, apart from a few exceptions such as Namibia, which is heavily dependent on food imports from abroad, the factors driving up food prices seem to have been strictly local, if the implementation of price support mechanisms and food price subsidies at the national level are not taken into account. In 2011, harvests were lower than in the previous year in all the countries where food prices grew the most, both because of deliberate actions by farmers, i.e. smaller planting as a response to exceptionally good harvests and low prices in the previous season, and for environmental reasons, such as scarce rains and droughts. In the Horn of Africa and in the Sahel region, dramatic droughts have caused famines that have made local prices skyrocket and at the same time increased the demand for food from neighbouring countries, thus affecting their prices as well.

In the picture described above, there is very little room to blame biofuels. The production of bioethanol

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and biodiesel in Sub-Saharan Africa is very limited and is mainly produced from residual molasses from sugarcane, which is already cultivated on a large scale for export-oriented production of sugar and does not directly harm food security. The use of all other crops analysed in this study is still at the experimental stage for biofuels production in the region. In many countries, crops such as maize have been ruled out for biofuel production in order to avoid competition with food.

From the perspective of biofuels mandates in developed countries such as the US and the European Union, this study very clearly shows the disconnect between international prices and local food prices in Sub-Saharan Africa. The numbers demonstrate that though food prices are rising in Africa, it is only a fraction of what is being experienced internationally, meaning that finger-pointing at food insecurity in Africa as a reason to end biofuel mandates in developed countries is foolhardy. When the demand created for additional commodities from biofuels mandates in developed countries is shown to raise international commodities prices, then the fact that Sub-Saharan Africa is predominantly shielded from that price instability must be highlighted. That lack of price transmission is key to understanding the real dynamics in the food and fuel competition debate so that the true drivers in food prices can be analysed and addressed. Continually blaming biofuels, however, will only serve to create discomfort in the global investment community and keep true economic development from reaching the continent.

> The degree of price transmission from international to local markets has been quite limited: price increases in the countries examined were on average lower than the relative rises in global food prices.

As discussed throughout the study, the Sub-Saharan African agricultural sector is currently far from realising its full potential. The adoption of more effective cultivation techniques and high-yielding seeds, together with a more widespread use of fertilizers could boost production on land that is already cultivated. Better cultivation techniques would make it possible to expand production also onto the vast amounts of marginal, low-potential land of the region, providing new markets and investment opportunities benefitting mainly poor farmers, etc.

So what the new edition of this report tries to do is pinpoint what issues are in fact leading to rising food prices in Africa, and leading to food insecurity if biofuels can't be blamed as easily as some would prefer. The report looks at issues like the overwhelming lack of investment in agriculture,

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storage, infrastructure and postharvest losses (PHL) as well as agricultural subsidies and trade barriers that are more closely related to food insecurity. This report looks at opportunities to mitigate these challenges.

At the heart of those improved agricultural yields is education, for both women and men, that ensures access to and understanding of techniques that can help them grow more and better food to supply their families and their communities.

But food security is not just about growing food, but about securing its supply and its access. The development of proper storage facilities would allow farmers to build up stocks and better face periods of scarcity thus ensuring a stable income throughout the year. Access to storage would help reduce PHL significantly, while introduction of bioenergy and other renewables into processing would provide increased income paired with increased market resilience.

Improving roads and market infrastructure would also incentivise the shift from subsistence to commercially-oriented agriculture. This would stimulate increases in production along with knock-on effects of improved incomes that lead to better education and access to more health care services. All of these are then reinvested into better agricultural yields thanks to healthy farmers with access to modern agricultural know-how.

On a larger scale, if implemented in sustainability criteria related to agriculture in general and to biofuels specifically, this shift to commercial agriculture would not involve the displacement of poor farmers from their land and would therefore greatly contribute to food security. At the policy level, local governments should seriously strengthen their agricultural sectors by improving and enforcing their land tenure systems, and subsidising crucial inputs such as fertilisers. Wider access to financial services, e.g. productive loans and insurance, would also encourage investments in agriculture.

Significant increases in production levels would help to ensure food security in Sub-Saharan Africa and at the same time would allow the sustainable development of a biofuels industry. When harvests are good, farmers respond to low prices by planting less in the next season, thus shrinking supply and causing price rises the following season. The section on food price analysis reports the examples of Uganda and South Africa's lower maize planting in 2011 following an exceptional harvest that reduced prices in 2010. If South Africa, for example, had better managed those four million tonnes of surplus maize and locally processed it into bioethanol for cooking and electricity, demand from the biofuel sector would have counteracted the falling price trend and therefore stabilised planted area and production capacity the following year.

Biofuels do not have to be blamed for price increases in Sub-Saharan Africa: on the contrary, the sustainable development of a bioethanol and

Biofuels do not have to be blamed for price increases in Sub-Saharan Africa: on the contrary, the sustainable development of a bioethanol and biodiesel sector could help to assist in the frequent swings in production caused by farmers' response to market prices by keeping demand for crops stable.

biodiesel sector could help to assist in the frequent swings in production caused by farmers' response to market prices by keeping demand for crops stable. In addition, local production of biofuels would also allow countries in Sub-Saharan Africa to reduce their dependency on fossil fuel imports and their heavy exposure to international oil price fluctuation, while decreasing the consequent high costs of agricultural activities. In the end, biofuels offer the opportunity for Sub-Saharan Africa to strengthen its agricultural sectors.

Large-scale production of biofuels in Africa, for Africa and for export, does have a role to play when done well, so it can achieve sustainable results for the local economy as well as participating in international biofuels trade.e. Small-scale need not be the only viable opportunity for bioenergy in Africa, but commercial-scale projects must be developed in such a way that lifts up and provides local economic development while not exploiting the local environment.

The biofuels debate in Europe and beyond must be focused on the true challenges to sustainable production, use and trade. Pointing the finger incorrectly, as demonstrated by the price analysis in this report, at allegedly negative impacts on African food security due to biofuels mandates outside the region only serves to inhibit the opportunities for development of a true bioeconomy in Africa and around the world. African food prices are impacted negatively by issues such as systemic lack of investment in agriculture and infrastructure, postharvest losses and climate change, but links between biofuels mandates and rising African food prices are weak at best. The focus should instead be on strengthening agricultural production in Africa so developing economies can at last achieve lasting economic development and end poverty.

Introduction

Between the second half of 2010 and the first half of 2011, international food prices experienced a sharp rise after having fallen back to near-normal levels following the dramatic spike seen in 2007/08. Again in the summer of 2012, fears over another price spike and its consequences led to concerns regarding existing biofuels mandates in the developed world. Underpinning the debate are lingering doubts about the benefits of biofuels and their potentially negative impact on developing countries, concerns that are also dampening the investment climate for the global bioenergy industry as a whole.

Looking at the dynamics of food prices during the past few years, the FAO food price index rose by 33% between June and December 2010, whereas the cereals price index peaked in April 2011 at 178.9, 65.8 points (58%) higher than in June 2010. Over the same period some staple food crop prices experienced an even steeper increase. International maize prices almost doubled and wheat prices grew by more than 70% between June 2010 and, respectively, April and May 2011. In August 2011, international sorghum prices were almost twice as high as in June 2010. Rice prices also increased by 37% between June 2010 and November 2011.

Of the many factors driving up food prices in 2007/08, biofuels were one of the most debated and controversial: research shows between approximately 20% and 75% of food price increases occurring between 2000 and 2008 were attributable to the worldwide demand for biofuels (World Bank 2008; IMF 2008; IFPRI 2008). The debate has not ceased and biofuels are yet again presumed by some to be largely responsible for the global food price rises that occurred in 2010/11 (Abbott 2011).

In Europe, the debate over Indirect Land Use Change is at full tilt; serious questions about the benefits from biofuels are at the heart of the debate. A main argument to end the use of and investment in first generation biofuels is potential competition with food, and every year just before the new harvest begins, the questions begin again in earnest just in case the harvest fails as it did in 2012.

The price dynamics witnessed during 2008 to 2011, however, mainly refer to commodities traded on international exchanges such as the Chicago Board of Trade. Domestic price dynamics in African countries can be completely different as price transmission from international to local markets depends on the extent to which the latter is integrated with the former. Other factors, such as the structure of domestic markets, the exchange rate of local currencies against the US dollar and the existence or lack of domestic infrastructure, determine transaction and transport costs (ODI 2008; OECD 2011; IEEP 2012). Impacts from agricultural subsidies in developed countries also have negative impacts on agriculture in developing countries, while postharvest losses have been shown to be a major inhibitor of food security.

Sub-Saharan Africa is a net importer of food and agricultural commodities. In 2010, an average of 10% of food merchandised in the region was imported, ranging between 5% in Zambia and 36% in the Gambia[4] (World Bank 2012). Higher food prices may lead to trade imbalances to which the mostly low income Sub-Saharan African countries may have difficulties responding. Food price increases are likely to have a particularly strong negative impact on the lives of Sub-Saharan populations: food makes up nearly half of household spending in the region (AfDB 2012), and even in rural areas many households are net buyers of food (IFPRI 2011). However, international trade restrictions are common in Sub-Saharan Africa, and in some cases are likely to block price transmission from international to local markets. Moreover, only certain food crops are imported from overseas, such

4 World Bank staff estimates from the Comtrade database maintained by the United Nations Statistics Division.

as rice and wheat; many staple crops, e.g. maize, are produced locally or imported through cross-border trade (IFPRI 2011).

The purpose of this report, therefore, is to examine the link between global demand for biofuels and the 2010/11 food crisis in the Sub-Saharan African region, and to understand the extent to which the former has influenced the latter. In order for the analysis to be as comprehensive as possible, this paper builds upon both statistical analysis and qualitative research. Food prices from 20 Sub-Saharan African countries have been compared to international commodity prices over the period 2010/11 in order to analyse the degree of price transmission from global to local markets. The analysis however does not consider the existence of food price support mechanisms at the national level, which may have had a fundamental role in smoothing price volatility.

This revised edition of *Who's Fooling Whom*, originally published in October 2012, goes beyond the original mandate to analyse what impacts there may be on African food prices in particular as a result of increased demand on the global commodities markets to supply biofuels mandates in Europe and the US. The original analysis found that there was indeed upwards price movements in these markets, but considering the disconnect between them and international markets, PANGEA sought with this new edition to outline some of the factors leading to those price increases and what could be done overall to increase food security in Africa as a whole.

Along with a description of the production of biofuels in the region, the paper offers an analysis of additional factors having a direct causal link to food price dynamics. PANGEA believes in fact that these factors, namely the low and declining productivity of Sub-Saharan African agriculture coupled with exceptionally unfavourable weather conditions, along with rising international oil prices have been the real drivers behind rising food prices. In Africa, issues such as postharvest losses mixed with poor agricultural production are in fact what drives food insecurity in the region, rather than the impacts of global biofuel production on local markets or the small volumes of biofuel production occurring in the region. This new edition of the report examines these issues in detail, both in the challenge they pose to food insecurity and opportunities to mitigate those challenges through policy change and increased, targeted investment in agricultural production and integration with bioenergy.

> Underpinning the debate are lingering doubts about the benefits of biofuels and their potentially negative impact on developing countries, concerns that are also dampening the investment climate for the global bioenergy industry as a whole.

The report is the result of desk-based research only and suffers from a fundamental unavailability or uncertainty of data[5] on food prices and biofuels production quantities in Sub-Saharan Africa. Price data has been mainly drawn from the FAOSTAT database, which often includes estimates rather than actual observations. Data on the production quantities of bioethanol and biodiesel in Sub-Saharan Africa can be found in a statistical review by BP (2012). This opens the way for further research based on direct data collection in the field.

5 For instance, no data on oilseeds such as castor and rapeseeds were available. As a consequence, biofuels made from such crops have not been included in the study.

Background

As shown in Figures 1, 2 and 3, the FAO food and cereals price indexes rose in the second half of 2010 and early 2011 and then declined after the second half of 2011, although they have remained higher than prior to the first price spike of 2007/08. Maize, sorghum and wheat prices (see *fig. 1* and *3*) followed the FAO indexes pattern, with the former two reaching even higher levels in 2011 than in 2007/08.

Dynamics in rice prices (see *fig. 2*) were different: their increase over the period 2010/11 was less marked than in all other commodities, but prices have continued to grow steadily even following the end of 2011.

The factors driving up global food prices in 2010/11 are believed to be similar to the ones responsible for the 2007/08 price increases, and may in fact be their consequence or continuation (IFPRI 2011). Although there is still a fervent debate on the topic, the main roots of the first price spikes have been identified in supply-side shocks determined by adverse weather conditions and production shortfalls; decreasing global stock-to-use ratio of grains that depressed food supplies worldwide; increased demand for livestock feed given: the improving living conditions and diets in emerging markets; financial speculation in commodities markets; restrictive trade policies in a number of countries, especially in the developing world; US dollar depreciation; crude oil price increases, that directly impacted the price of agriculture inputs such as fertilisers; and growing demand for biofuels, caused by higher oil prices and biofuel mandates in developed countries (Trostle. 2008; Abbott & Borot De Battisti. 2011; IFPRI 2011; World Bank and IMF 2012). According to a joint study of various international agencies including OECD, FAO and IFAD (2011), during the 2007-2009 period biofuels accounted for 20% of global sugarcane use, 9% of vegetable oil and coarse grains, and 4% of sugarbeet, and projections agree on their potential to exert upward pressure on food prices.

As for the most recent price increases in 2010/11, Abbott et al. (2011) found that 27% of the total US maize crop was used for ethanol production in 2010/11 compared to 10% of the 2005/06 crop. Trostle et al. (2011) argue instead that attributing

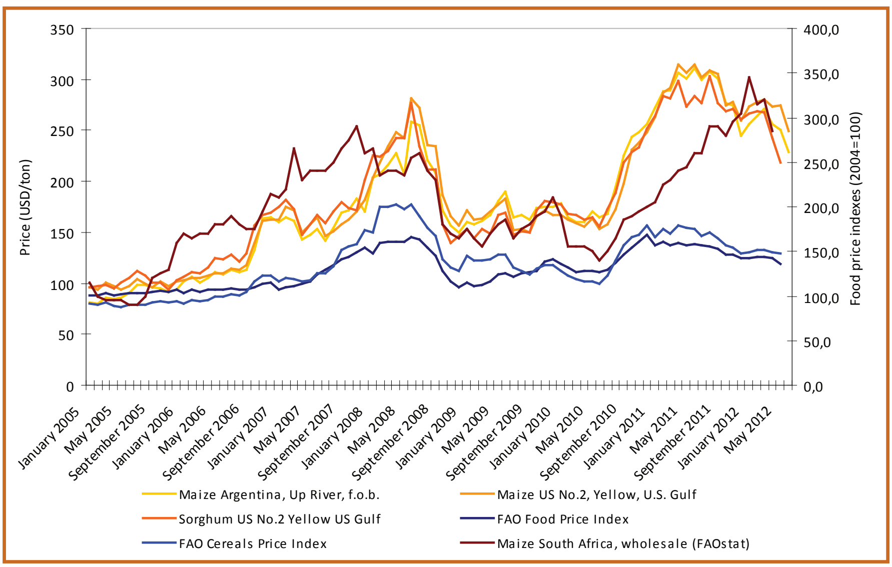

FIGURE 1. International and South African maize and sorghum price dynamics, FAO Food and Cereals Price Indices

Source: FAO 2012a

Trostle et al. (2011) argue instead that attributing a large part of the rise in food prices to biofuels is unrealistic: while food prices have been fluctuating strongly in the last four years, biofuels production and demand has been growing steadily.

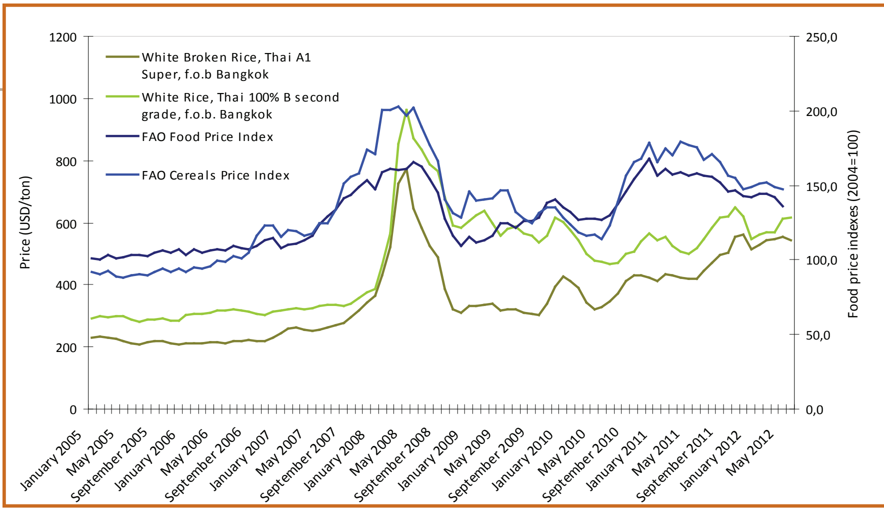

FIGURE 2. International rice prices, FAO Food and Cereals Price Indexes

Source: FAO 2012a

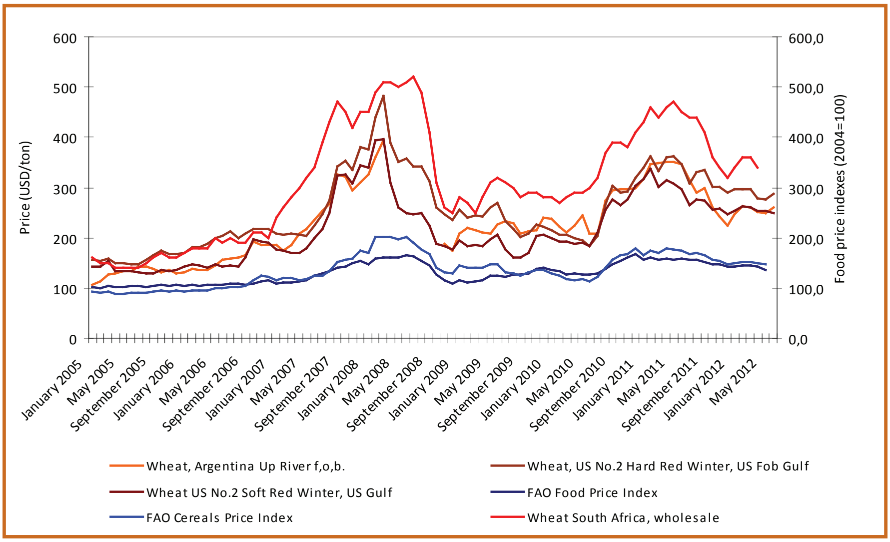

FIGURE 3. International and South African wheat prices, FAO Food and Cereals Price Indexes

Source: FAO 2012a

a large part of the rise in food prices to biofuels is unrealistic: while food prices have been fluctuating strongly in the last four years, biofuels production and demand has been growing steadily. A report by the World Bank and the IMF (2012) suggests that biofuel mandates in developed countries have boosted demand for grains and consequently have reduced the price elasticity of demand for such commodities[6].

Research shows that weather has had a greater role in the more recent food crisis (Abbott et al. 2011; Trostle et al. 2011). Abbott et al. (2011) add three further issues as key drivers of the price increases in 2010/11: market inelasticity, Chinese policy and soybeans imports, and the rapid expansion of maize and vegetable oil for biofuel production.

6 The price elasticity of demand is defined as the degree of the responsiveness of the quantity demanded of a good to a change in its price (Investopedia 2012) http://www.investopedia.com/terms/p/priceelasticity.asp#axzz1zZar0NgW, accessed on 1 June 2012). The smaller the elasticity, the greater the price increases in case of an increase in the quantity demanded.

Biofuels Production in the World and in Sub-Saharan Africa

The supply of biofuels worldwide is dominated by three main producers: the United States, Brazil and the European Union. In 2011, the US produced 48% of the world's biofuels supply, followed by Brazil (22%) and the EU (17%). Asian countries, Australia, Canada and other South American countries jointly made up 12.8% of the world's production, while the entire African continent produced less than 29,000 metric tonnes of oil equivalent (212,570 barrels), constituting 0.01% of the total global supply (BP 2012).

In the last couple of years, the United States has become a net exporter of maize-based ethanol. During the 1990s and 2000s it imported small quantities of ethanol mainly from Brazil, Canada and the Caribbean (Costa Rica, El Salvador, Jamaica, Trinidad and Tobago), while about 5,500 metric tonnes of oil equivalent (40,000 barrels) were imported from Congo Brazzaville in 2006 (US Energy Information Administration 2012).

Brazil has also been traditionally a net exporter of ethanol, and the quantities it imported over the last decade – mainly from the US, the UK and the Netherlands – were insignificant compared to its exports (AgroStat Brasil 2012). Though the country remains a net exporter, its imports have increased significantly recently with imports passing 978,250 metric tonnes of oil equivalent (7,163,800 barrels) in 2011, up 1,428% over 2010 (Americas Society 2012). As for biodiesel, which is mainly produced and consumed in the EU, exports over the 2000s have exceeded imports in all major producing countries (UNdata 2012).

In Sub-Saharan Africa, the production of biofuels is in fact still limited and presents a considerable heterogeneity across the region. Small quantities of ethanol are shipped from some African countries to the EU due to preferential access to the EU market, but in general, African biofuels are not yet competitive on the world market (Aidenvironment 2008).

Some countries, such as Burkina Faso, Malawi, South Africa and Zimbabwe have a long tradition of biofuels production (starting in 1920 in South Africa, and in the 1970-80s in the other countries), however it has never reached large scale. The reasons behind this limited development are rooted in the lack of appropriate policy frameworks, in environmental issues, in the relative value of ethanol in different markets –in Zimbabwe, where a heavy drought in 1992 forced the country to give up production for the next two years where ethanol was then worth more in the alcohol industry than as transport fuel – but also in the availability of cheap and abundant oil (IIED 2007).

Other countries, such as the Democratic Republic of the Congo, Ethiopia, Mauritius[7,8], Sudan and Swaziland, are long-time sugar and ethanol producers, with some local companies recently engaging in expanding their production and allocating a larger share of their harvest to ethanol distillation. Sudan is a peculiar case

7 http://www.lexpress.mu/story/32688-saint-aubin-se-lance-dans-les-sucres-speciaux-l-ethanol-et-les-bio-fertilisants.html (accessed on 10 June 2012)

8 http://www.bloomberg.com/news/2011/01/04/omnicane-of-mauritius-to-start-producing-ethanol-by-june-express-reports.html (accessed on 10 June 2012)

since following South Sudan's declaration of independence in July 2011, it 'lost' three quarters of its oil production, which had previously been the country's main source of income: the development of the sugar industry, which is already the third largest in the continent after South Africa and Egypt, is essential to compensating for the excess demand for fuel, but also to help revive Sudan's economy[9].

In a number of Sub-Saharan countries, biofuel production has recently been initiated by local public and private sector actors. In Rwanda, two companies, Rwanda Biofuels Ltd and the Rwanda Biodiesel Company Ltd — the latter created by the Scientific and Technological Research Institute (IRST) — are the main producers of biodiesel from jatropha and palm oil, which are cultivated locally and imported from neighbouring countries. In Botswana a project for jatropha biodiesel production was launched in 2010 and entirely funded by the National Petroleum Fund[10].

Nigeria set 10% ethanol and 20% biodiesel blending targets to be reached by 2020. It expects to be able to produce enough biofuels for its own national needs by then while it imports ethanol from Brazil in the interim. In Kenya, Consumers' Choice Ltd, a local company whose mission is to promote clean cooking energy fuels and solar lighting, developed in 2011 a bio-ethanol gel for cookstoves made from molasses derived from sugarcane (OilPrice.com 2011). A sugar and ethanol project was started in April 2012 by a joint venture of the Kenyan Kwale International Sugar Company Ltd and the Mauritian Omicane (Business Daily Africa 2012).

The bulk of investments in the biofuels sector in Sub-Saharan Africa are, however, made by foreign investors. The region's fundamental lack of local finance hampers the development of its agricultural sector. Mali is home to the first biodiesel company in West Africa, Mali Biocarburant S.A. (MBSA), which works sustainably with more than 8,000 smallholders who also hold company shares. The company was mentioned as a positive example by the UN Special Rapporteur on the Right to Food, Olivier De Schutter, at the UN General Assembly[11] despite his traditionally negative stance on biofuels (Mali Biocarburant SA 2012).

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Sierra Leone is home to a large-scale sugarcane ethanol project by the Swiss company Addax, launched in 2011 and mainly aimed at producing ethanol for export to the EU. Prior to

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9 http://www.brecorder.com/agriculture-a-allied/183/1163604/ (accessed on 10 June 2012)

10 http://www.mmegi.bw/index.php?sid=1&aid=1198&dir=2010/March/Wednesday24 (accessed on 10 June 2012)

11 Excerpts from his speech are available at http://www.srfood.org/index.php/fr/component/content/article/1-latest-news/1704-farmers-must-not-be-disempowered-labourers-on-their-own-land-un-right-to-food-expert (accessed on 10 June 2012)

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the investment, which was partly financed by the African Development Bank and several other European DFIs, Addax conducted an extensive analysis of the environmental, social and health impacts of the project. Compliant with the performance standards of the International Financial Corporation, the Roundtable on Sustainable Biofuels and Bonsucro standards, received in early 2013 its RSB certification. The company also launched a food production project in cooperation with the Food and Agriculture Organisation of the United Nations, the International Institute of Tropical Agriculture, and the Ministry of Agriculture and Food Security (FAO 2012a).

In March 2012 a sugarbeet ethanol production project, financed by Webco, started in Bungoma, Kenya. Farmers who agreed to be moved will be compensated financially and the production will be sold in bulk to the Kenyan National Oil Corporation and to Kenol Kobil, one of Africa's leading oil companies, as per the Biofuel Purchase Agreement and Energy Act (Daily Nation 2012). Since the early 2000s, jatropha plantations for sustainable biodiesel production have been introduced in the south of Madagascar by international companies Tozzi Green and GEM Biofuels. Angola has also recently entered the biofuels arena through investments by predominantly Brazilian companies while Zambia has been seen as a very attractive country for biofuel feedstock cultivation such as jatropha and sugarcane, and their processing into biodiesel or bioethanol.

Generally speaking, in the last few decades attention towards biofuels has been growing steadily in Sub-Saharan Africa. The widespread reliance on imports of fossil fuels has had a detrimental impact on many of the region's countries' balance of payments, especially at times of high oil prices. The majority of governments in the region have passed or are developing appropriate legislation allowing for the smooth development of a sustainable biofuels industry, while some have also introduced blending targets (PANGEA 2011a).

It is the lack of or inefficient implementation of such national land use legislation which gives way to illegitimate land appropriation – so-called "land-grabbing" – by some biofuels companies (PANGEA 2011b). That has been the case in countries such as Ghana, Tanzania and Senegal (Biofuelwatch 2008, ActionAid 2012, RFI 2010[12]), where thousands of hectares of land were granted by the government to foreign investors without the farmers' consent, or promises of compensation where not fulfilled. The International Land Coalition claims the African continent is the apparent prime target of the recent 'land rush' with 134 million hectares of reported land deals (ILC 2011) though questions remain about the data because it hasn't been verified on the ground.

Research is however in disagreement on the role of biofuels as a the trigger for this phenomenon: while in its original report the ILC (2011) indicates that three quarters of the deals for agricultural production (the latter accounting for 78% of the total) are for biofuels, reports by Oxfam (2011) and Hall (2011) indicate that as much as three quarters of the land acquired is for crops other than for biofuels. PANGEA fights to ensure sustainability and equitability in African bioenergy production and considers the ineffectiveness of land tenure systems in Sub-Saharan Africa to be the greatest determinant of this wave of unfair land acquisitions (PANGEA 2011b).

12 http://www.english.rfi.fr/africa/20111028-biofuel-project-breeds-violence-senegal (accessed on 12 June 2012)

Agriculture in Sub-Saharan Africa

In order to provide a consistent evaluation of the phenomenon of food price volatility, it is essential to take into account the supply side. The following sections provide an overview of the agricultural sector in Sub-Saharan Africa and the challenges it faces. The next two sub-sections examine in more detail the production of the most commonly used, or most promising, feedstocks for biofuels in the region as well as the main staples in the African diet.

Features of the Agricultural Sector in Sub-Saharan Africa

Agriculture is a sector of crucial importance for the Sub-Saharan region. The sector provides 63% of total employment[13] in the region (46% including South Africa), and the share of gross domestic product from agriculture ranges from 5% in countries such as Botswana and Gabon, up to 52% in Ethiopia and Sierra Leone, with a regional average of 15% (27% including South Africa). Agriculture in Sub-Saharan Africa is dominated by smallholder farmers, i.e. owning 2 hectares or less, who represent 80% of all farms and produce up to 90% of the total agricultural output (IFAD 2011).

Notwithstanding its essential role in the economy of Sub-Saharan Africa, the agricultural sector suffers from a series of ailments that prevent it from realising its full potential. First of all, land is underutilised in the region: Africa is home to up to 60% of the world's under-utilised land (DTI 2011). About 45% of available land is deemed suitable for agriculture (IFAD 2011) and three quarters of existing farmland is heavily depleted as continuous farming has not been offset by an appropriate replenishment of nutrients (AGRA 2012). Moreover the use of fertilizers in the region is extremely low (3% of global fertilizer consumption; 7 kg/ha versus over 150 kg/ha in Asia). Market failures on the demand side – poor price incentives; lack of financial resources; lack of information about fertilizers – hence inability of the producers to reach economies of scale, have all been major factors in low productivity. Fertilizers in Sub-Saharan Africa are the most expensive in the world (FAO 2012a). In addition, most agriculture in the region is rain-fed with the use of irrigation systems still limited. The most advanced farming techniques often do not get to out-of-reach rural areas.

> The maize-wheat price relationship is much less visible in Sub-Saharan Africa, despite the region's heavy dependence on international wheat markets.

As a result, land productivity is low and stagnant, as is highlighted by the fact that increases in production throughout the last 50 years have

13 Sources quoted were not clear on the breakdown between formal and informal employment.

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closely followed, and sometimes fallen below the rate of increase in inputs (IFAD 2011; IFPRI 2011). Sub-Saharan Africa is already dependent on imports of food that could be produced locally, and with its population growing at a rate of 2.5% a year (World Bank 2012), the gap between demand and supply of food is on the increase.

Climate change impacts

Another major factor affecting food supply in Sub-Saharan Africa is climate change. Although the region as a whole accounts for less than 4% of worldwide CO2 emissions (Chemnitz & Hoeffler. 2011), Sub-Saharan Africa, and its agricultural sector in particular, are extremely vulnerable to worsening weather conditions.

The serious drought in the Horn of Africa in 2011 caused a substantial rise of food prices in the area, and pushed thousands of people into malnutrition (Nebehay 2011). The Sahel region has been affected by severe droughts in 2005 and 2010 and is facing an ever-harsher crisis threatening millions of people with hunger (WFP 2012). Leaving aside such extreme weather events, which however limited geographically, are predicted to become more and more frequent as a result of climate change (Auffhammer. 2011; WFP 2012).

Temperature increases have had and could continue to have disastrous consequences on agriculture in Sub-Saharan Africa, and water availability for 75 million to 250 million people on the continent may be heavily affected by 2020 (IFAD 2011). Higher temperatures may translate into reduced harvests for all main staple crops: Schenkler and Lobell (2010) found, with a 95% probability, that worsening weather conditions, namely higher temperatures, will decrease the production of cassava, sorghum, millet and maize by respectively 8%, 17%, 17% and 22% by mid-century. There is also a 5% probability that these losses, except for cassava, will exceed 27%. The absence of storage facilities, hence the low stock-to-use rate in the region, make it even harder to face poor harvests and famines (Abbott et al. 2011; Songwe 2012).

The challenge of smallholders

The list of challenges facing Sub-Saharan African agriculture unfortunately does not stop there. Being a sector dominated by smallholders, agricultural production is mainly at subsistence-level. Unclear land tenure rights and lack of access to finance play important roles in slowing the transition to commercially-oriented production, the impact of which may lead to farmer displacements and thus worsen food security.

An additional major factor is market access: lack of road infrastructure connecting rural to urban areas, high transport costs and lack of market places in rural areas prevent smallholder farmers from realising profitable returns on their investment. Rising oil prices have made transport costs increase dramatically over the last decade, thus adding further hindrances to poor farmers' access to markets on the one hand, and on the other hand exerting upward pressure on food prices.

The impact of oil

As mentioned in the previous section, the close link between oil and food prices is a point on which researchers agree. In fact, the cost of crude oil does not only have an impact on transport costs:

farm machinery is fuelled with oil and it is also used as an input in agricultural chemicals. Sub-Saharan Africa is heavily dependent on imports of fossil fuels for energy generation and transport. Most countries in the region – exceptions being oil-producing countries such as Nigeria, Angola and South Africa – depend entirely on imported petroleum products and therefore are vulnerable to global oil price dynamics.

There is a distinct disconnect between agricultural growth and the base-economic success of these countries. Significant research has been done in the area of African economic growth where areas with high levels of success are often linked with a growing export trade in oil (IMF 2011). However, the importance of growth in the agricultural industry has been underplayed. Some analysts have estimated that the agriculture and agribusiness industry combined will reach a zenith in monetary terms relatively soon with market values of around US$1 trillion set to be reached by 2030 (World Bank 2013). It suggests future success in attracting agricultural investment through government policies and free-trade agreements rather than the relatively low levels of investment coming from foreign investors in the form of aid.

Increased productivity hasn't solved the problem

The last few decades have seen increases in productivity and yields for most countries in the region, with growth in production from 1960-2007 reaching just less than 1% per year (Chauvin et al. 2012) in comparison with South America's rapid increase in food production of 70% from 1962-2006 (Wiggins & Leturque. 2010). However on a regional scale, there have been rates of growth far exceeding population growth. North and West Africa have seen 52% and 46% growth in food production respectively (Wiggins & Leturque. 2010). There was higher than average growth in South Africa, Ethiopia and Ghana, especially with selected foods, such as roots and tubers (Chauvin et al. 2012).

> Rising oil prices have made transport costs increase dramatically over the last decade, thus adding further hindrances to poor farmers' access to markets on the one hand, and on the other hand exerting upward pressure on food prices.

Despite economic growth and increased agricultural investment, food insecurity is ever-present. The FAO says that net US$11 billion is needed in agriculture investment annually if the region is to address this issue by the year 2050 (Hallam. 2009). A case study on Ethiopia conducted by Deutsche Bank estimated projected investment in agribusiness from foreign investors at more than US$2.5 billion[14]. The largest investor was Saudi Arabia, followed by India. This foreign and private interest in investment in land peaked in 2009 with 30 million hectares reportedly sold worldwide, compared to just over 5 million

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14 Deutsche Bank 2012

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hectares in 2008[15]. Africa netted the largest amount of deals in hectare size throughout the last decade. These foreign investments drive up the prices locally as food that would be earmarked for local consumption is exported to other regions, stressing once more that there is food available, but it isn't always available locally to those who need it.

Government policies in attracting private investment are also on the up. For example, Ghana and Nigeria have implemented a zero-duty policy on agricultural machinery (Mhlanga. 2010). Unions and alliances of states such as AGRA (the Alliance for a Green Revolution in Africa), CAADP (Comprehensive Africa Agriculture Development Programme), ECOWAS (The Economic Community of West African States) and the ACP (African Caribbean Pacific) group of countries have enabled the scaling up of agribusiness investment. This has facilitated a growth in 'South-South' trade. Once again a positive picture for the economy of the region at a larger scale is drawn among rising trends in agricultural investment.

Turning to the prospects for smallholder farmers, three interlinked developments have meant this segment of the population is now back on the agenda: firstly, climate change concerns about cropping; secondly, the global food price spikes in 2008 and subsequent price plateau; and thirdly, the underlying, long-term and persistent chronic levels of hunger in the region.

However, this renewed attention from both national governments and international bodies has meant that over the last few years, prior to the economic crisis, increases in development aid lead to positive changes in the outlook for smallholders. These developments are centred on both the demographic and economic changes discussed previously.

The barriers to development for smallholders are manifold. Key among them is squeezed income, a factor discussed in more detail later on in this report. But some policymakers are addressing other looming challenges:

Decision-making: smallholders are rarely represented at a local or national level, and there is a lack of localised bodies aimed at including this important voice (Livingston et al 2011). Individual farmers lack the power and time to lobby for investment. Governments are beginning to understand this. Nigeria through its recently appointed Minister for Agriculture, Akinwumi Adesina, has been able to innovate and look at the potential of mobile phones for surveying the smallholder populace to include their voice. This model could be scaled to access localised market information to improve trade opportunities. This example of initiative can be easily replicated across the continent, with 619 million mobile connections across 25 African Countries in 2011; Nigeria has the largest share of 89 million[16].

Infrastructure and access to markets: road and haulage costs as well as rocketing fuel prices from expensive imports and its effects on access to markets pose major challenges. Lack of information on quality and quantity requirements mean smallholders are not able to access more lucrative markets with any surplus that may be produced. However, there are solutions at hand by disseminating information on more resilient and disease-resistant crop varieties. Five hundred farmers in Kenya used selective breeding to increase their yield six-fold (Livingston et al 2011). To prevent this undermining the local market rates for cassava, processing facilities were set up to produce chipped cassava and flour, adding value for the

15 Ibid.

16 GSMA 2011

local farmers (Livingston et al. 2011). Examples such as these show that there is a potential for increasing yields in African agriculture even at smallholder level.

Finance and ownership: the lack of prospective credit schemes hampers the ability of smallholders to cope with shocks and risk. Weather-related shocks such as drought or flood can mean that a farmer will find it difficult to sustain any crops, and in a worst-case scenario, difficult to feed families. With micro-insurance programmes, if drought or flooding strikes in one area, farmers can recover through re-cropping after claiming through insurance. This majority stakeholder group of smallholder farmers could not have previously benefited from before policies covering small capital costs were developed.

Equality: this is a particular challenge as women provide up to 70% of the agricultural labour force (FAO 2011a), but who in many countries do not have any say in financial decisions or own any land. In Cameroon, women undertake an average of 75% of agricultural work while owning less than 10% of the land[17]. Traditional arrangements that leave the bulk of agricultural work to women typically see 20%-40% lower yields than on plots farmed by men[18]. But giving women better positions from which to make decisions through providing access to finances and land ownership would likely reverse this trend (FAO 2011b).

Furthermore, local corruption and political instability can see crop yields fall and the incomes of the poorest sections of society further squeezed. A period of relative stability in Sub-Saharan Africa has seen yields bounce back and this combined with smarter investment in crop varieties and intercropping mean that the outlook does give cause to be positive, albeit with caution.

17 UNICEF 2007
18 Gates Foundation 2013

Biofuel Crops in African Agriculture

At the moment the most commonly used feedstock for bioethanol in Sub-Saharan Africa is sugarcane. Its cultivation is already widespread across the SSA, and it is mostly produced on large-scale plantations. Sugarcane is not a staple food crop, therefore its use for biofuel production does not directly harm food security. Moreover, in Africa ethanol is almost exclusively produced from molasses, which is a residue from processing sugarcane into sugar. Sugarcane is also the highest yielding crop in terms of energy per hectare; however, in Africa yields are much lower than in Brazil (Aidenvironment 2008) hence there is room for its improvement in the region.

A series of studies have been conducted by both local governmental bodies and international development agencies examining the feasibility of biofuels production in Sub-Saharan Africa and identifying the most suitable crops to this end. These studies highlight that apart from sugarcane, the most promising biofuels feedstocks in Sub-Saharan Africa are maize (which was ruled out by many governments in order to avoid competition with food), cassava and sweet sorghum for ethanol; and oil palm, castor and jatropha for biodiesel (Aidenvironment 2008; PANGEA 2011a). Cassava, maize and sorghum are widely cultivated in the region. Cases of large-scale production are however rare and their use as biofuel feedstock at the moment is extremely limited. They are also some of the most important staples in the African diet: the top sources of calories for Sub-Saharan Africa as a whole are, in order, maize, cassava, rice, sorghum, wheat and millet (FAOSTAT 2012).

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Given the limited availability of statistics on biodiesel production and trade in Sub-Saharan Africa, only the bioethanol crops will be analysed in this section. The next section will examine the remaining three main staples in the African diet, i.e. millet, rice and wheat.

Figures 4 to 7 show data on the quantities produced and traded of the four bioethanol crops (plus sugar) in Sub-Saharan Africa between 2000 and 2010. Data on imports and exports refer to trade flows that occurred both within the region and with the rest of the world. Figures 9 to 12 also show the evolution of their produced quantities, harvested areas and yields throughout the 2000s.

Some important conclusions can be drawn from the graphs above. First of all, Figures 4 to 7 show clearly that all four commodities apart from sugar are mainly produced and consumed locally, as imports and exports are minor when compared to local production. It is sensible to say that African markets for such crops are quite isolated from the international ones, therefore the factors driving price rises are to be looked for locally: unfavourable weather

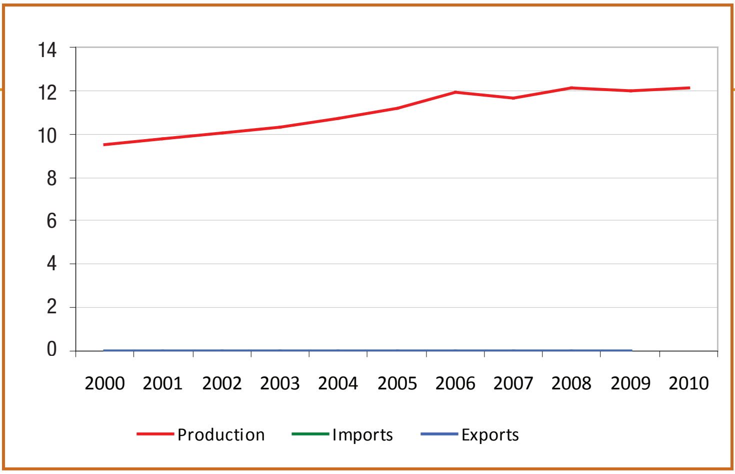

FIGURE 4. Cassava production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

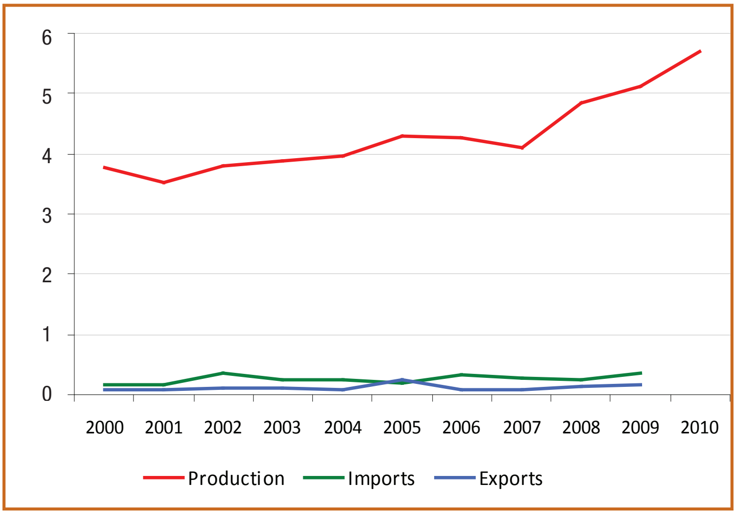

FIGURE 5. Maize production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

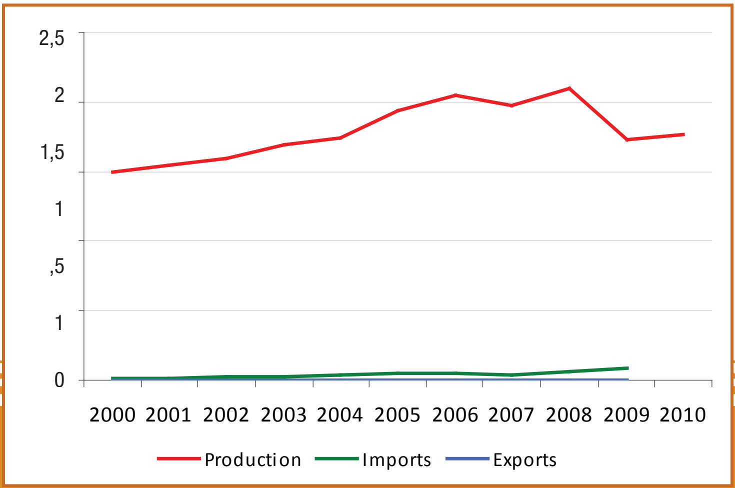

FIGURE 6. Sorghum production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

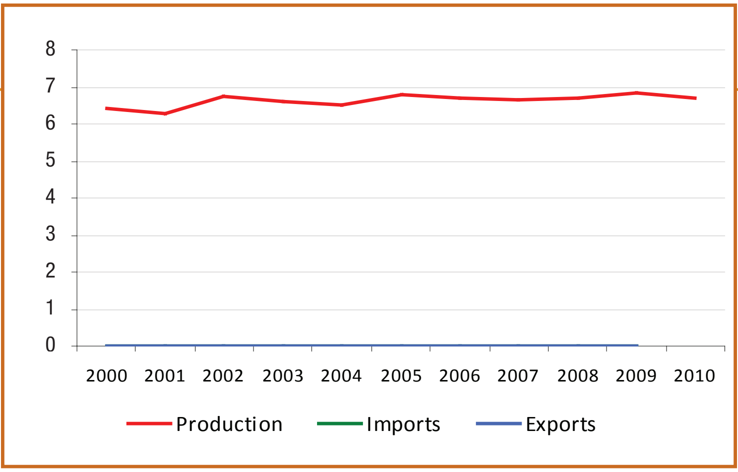

FIGURE 7. Sugarcane production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

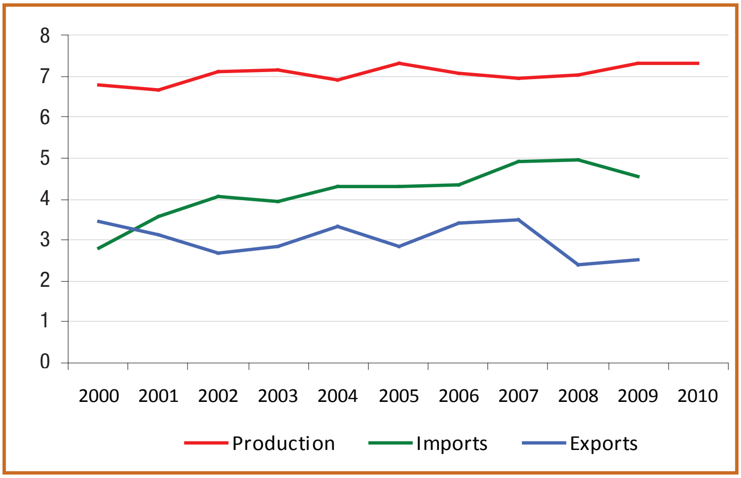

FIGURE 8 Sugar production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

conditions depressing an already low productivity level at a time of rising demand both locally and from abroad, coupled with poor storage infrastructure which impedes buffering low harvest seasons, mixed with rising input and transport costs. Figure 5 also shows how producers respond to market incentives: in 2007 maize production started growing faster than over the previous years, most probably due to the exceptionally high prices that pushed farmers to increase yields with the aim of increasing revenues. Sugar is instead largely produced, exported and imported.

The poor condition of infrastructure across the region is also key to understanding the very limited extent to which these crops are exported. While impeding trade in primary commodities – in this case, export of feedstock for biofuel production in advanced economies - this constitutes an incentive for local distillation and export of the higher-value final product, ethanol. A typical example of the need for local production is bioethanol from sugarcane: canes have to be processed shortly after being cut, hence given the already discussed lack of or poor status of road infrastructure, factories need to be located close to the fields.

In Sub-Saharan Africa, ethanol is mainly distilled from molasses, a by-product of sugar processing and is therefore readily available in the same factory where sugar is refined. It, like biofuel production from grain, oilseeds and vegetable oils, on the other hand, don't have kinds of transportation limitations imposed on them as do sugarcane and sweet sorghum yet local infrastructure challenges still impede potential trade in feedstocks.

Figures 9 to 12 confirm that agricultural productivity in Sub-Saharan African is low and stagnant,

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thus unable to keep pace with growing demand. It can be observed that in all four cases the production quantities, areas harvested and yields have followed approximately the same pattern, hence proving that increases in production have been mainly determined by increases in the cultivated area rather than improvements in cultivation techniques. The disappointing exception is sugarcane, whose production grew even less than the harvested area over the period considered despite the perfect conditions for sugarcane growing in many African regions. Production of cassava and maize grew steadily throughout the years, with harvests in 2010 being, respectively, 27% and 51% higher than in 2000. Sorghum production peaked in 2008 and then fell to 2003/04 levels, while sugarcane harvests remained stable throughout the 2000s.

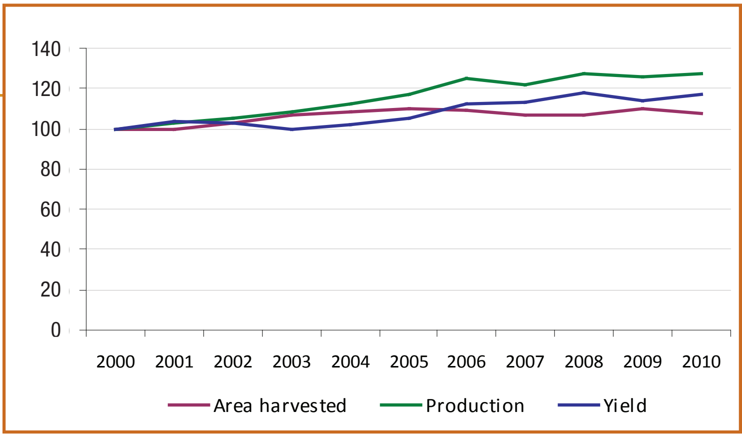

FIGURE 9. Cassava: area harvested, production and yield 2000-2010, 2000 = 100
Source: FAOSTAT

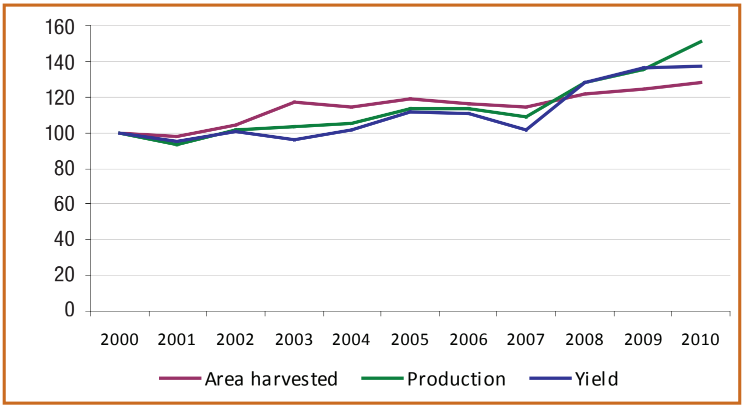

FIGURE 10. Maize: area harvested (Ha), production (million tonnes) and yield (Hg/Ha), 2000-2010, 2000 = 100
Source: FAOSTAT

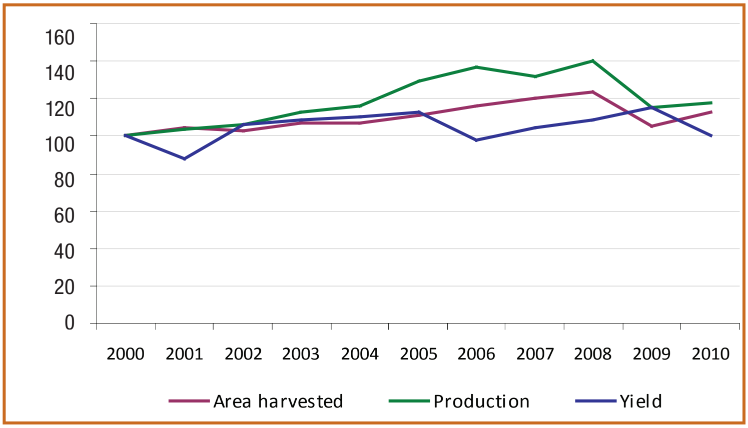

FIGURE 11. Sorghum: area harvested (Ha), production (million tonnes) and yield (Hg/Ha), 2000-2010, 2000 = 100
Source: FAOSTAT

Staple Crops in Sub-Saharan Africa

This section analyses the production of three key crops: wheat, rice and millet. Their relevance in this study does

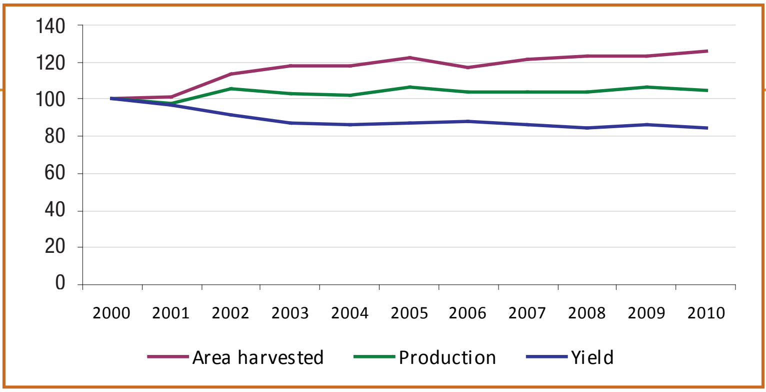

FIGURE 12. Sugarcane: area harvested (Ha), production (million tonnes) and yield (Hg/Ha), 2000-2010, 2000 = 100
Source: FAOSTAT

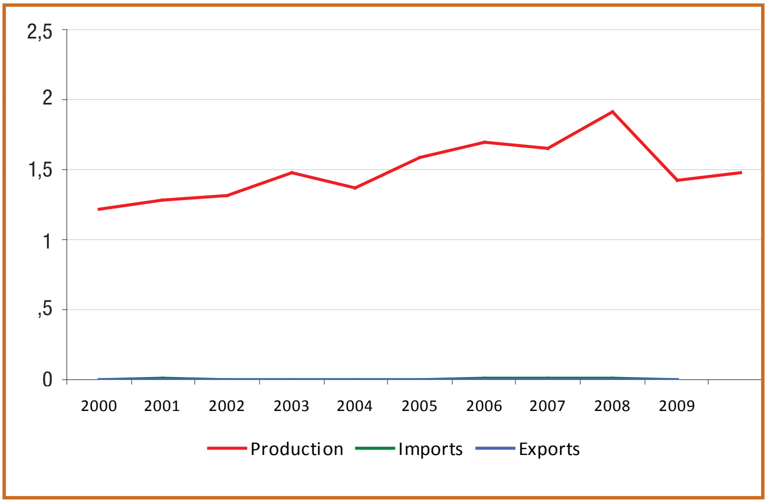

FIGURE 13. Millet production and trade in Sub-Saharan Africa (tonnes), 2000-2010
Source: FAOSTAT

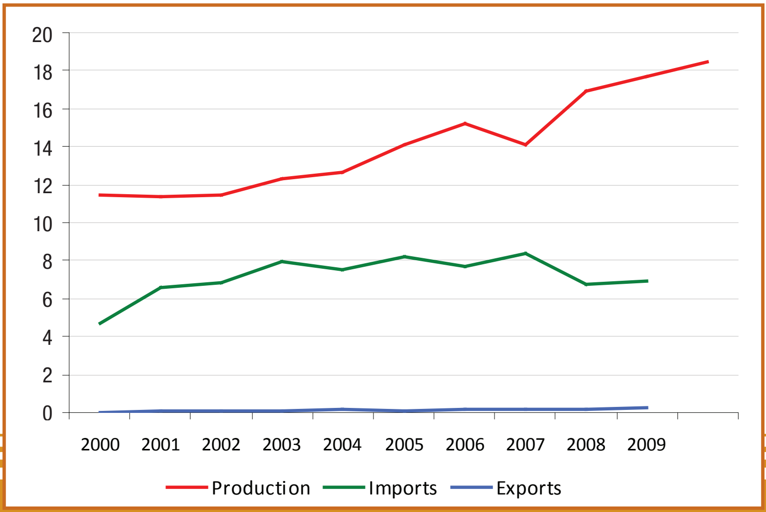

FIGURE 14. Rice production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

not only relate to the fact that they are three of the main staples in the Sub-Saharan African diet. Since wheat and rice are two of the commodities whose international prices experienced the highest increases during both recent food crises, demand in Sub-Saharan Africa is mainly met through imports. Although rice and millet are not common feedstocks, they are often included in the food versus biofuel debate when considering the "substitution effect"[19] derived from the increased price of other crops utilised for biofuel production, i.e. maize.

As in the previous section, the following graphs show the production and trade patterns, as well as the evolution of production, harvested area and yields of the three staple crops.

Millet is typically a local crop as is demonstrated by the extremely low

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19 The "substitution effect" is defined as the idea that as prices rise (or income decreases) consumers will replace more expensive items with less costly alternatives. Source: http://www.investopedia.com/terms/s/substitution-effect.asp#axzz20szip3RU

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quantities imported and exported (see *fig. 13*). Area harvested and yield have changed little since 2000, while production grew between 2004 and 2008 and then fell to 2004 levels.

Figures 14 and 15 highlight how the consumption of rice and wheat in Sub-Saharan Africa is heavily dependent on imports. Throughout the 2000s, the quantity of imported rice fluctuated on average between 39% (in 2009) and 65% (in 2003) of local production in the whole of Sub-Saharan Africa, while in Middle Africa[20] it never went below 73% and reached a peak of 170% of production in 2004 (FAOSTAT 2012). Figure 14 shows that exported quantities of rice were extremely low in the region. It is clear that although local production is greater than imports, rice is mainly imported from countries outside Sub-Saharan Africa. African rice imports represent a third of the total quantity traded on the global market, with its main suppliers being Thailand (60% of imported quantity in 2000-2002), China (22%) and Pakistan (9%) (WARDA 2007). The production of rice has been on the increase since 2000 - given price increases and consequent incentives to expand yields already discussed in the previous section. The 2010 harvest was the best of the decade. Rice production has also been increasing faster than the size of areas harvested.

This exposure of African food markets to global markets for rice is a marked difference in comparison to cassava, maize, millet and sorghum that are

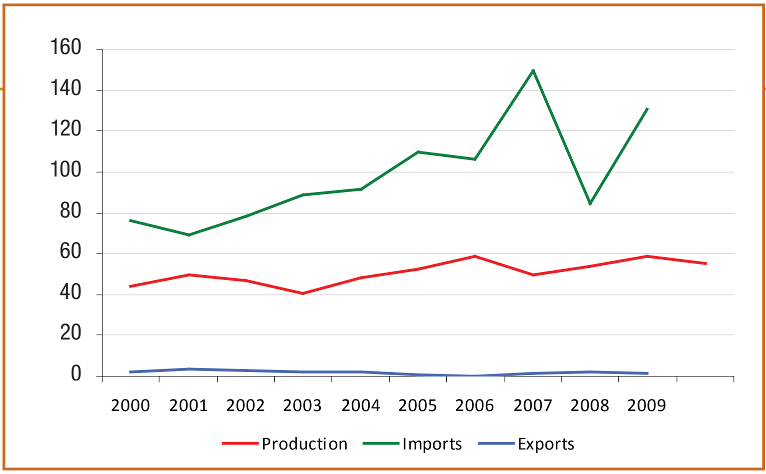

FIGURE 15. Wheat production and trade in Sub-Saharan Africa (million tonnes), 2000-2010
Source: FAOSTAT

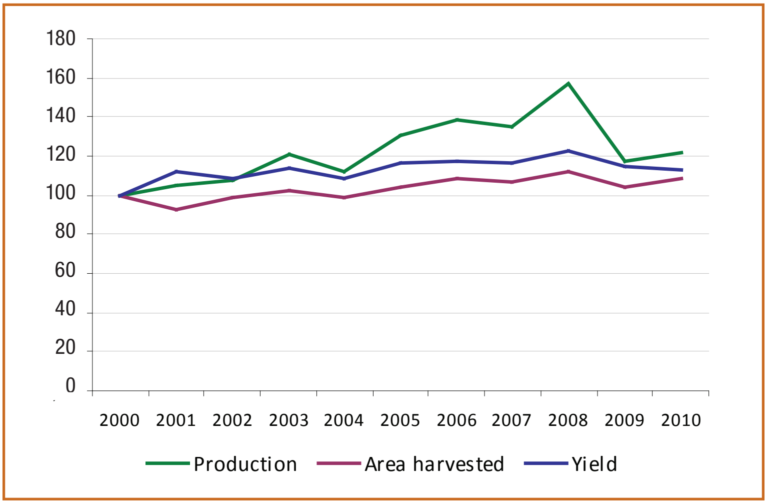

FIGURE 16. Millet: production (tonnes), area harvested (Ha) and yield (Hg/Ha), 2000-2010, 2000 = 100
Source: FAOSTAT

20 FAOSTAT geographic grouping: Angola, Cameroon, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Sao Tomé and Principe.

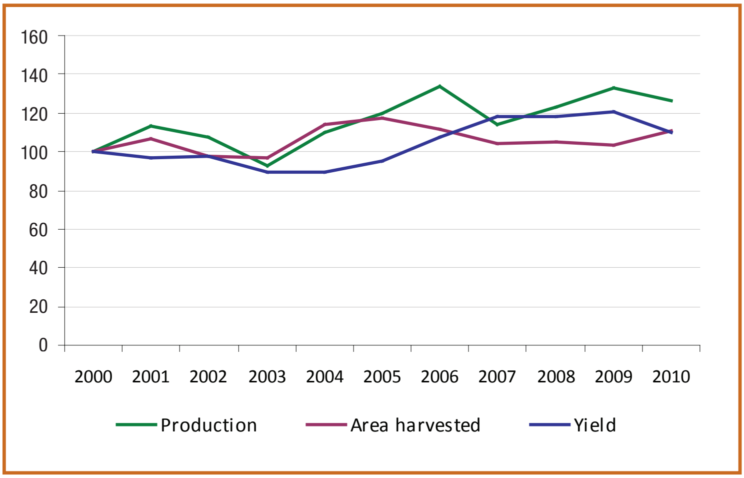

FIGURE 17. Rice: production (tonnes), area harvested (Ha) and yield (Hg/Ha), 2000-2010, 2000 =100 Source: FAOSTAT

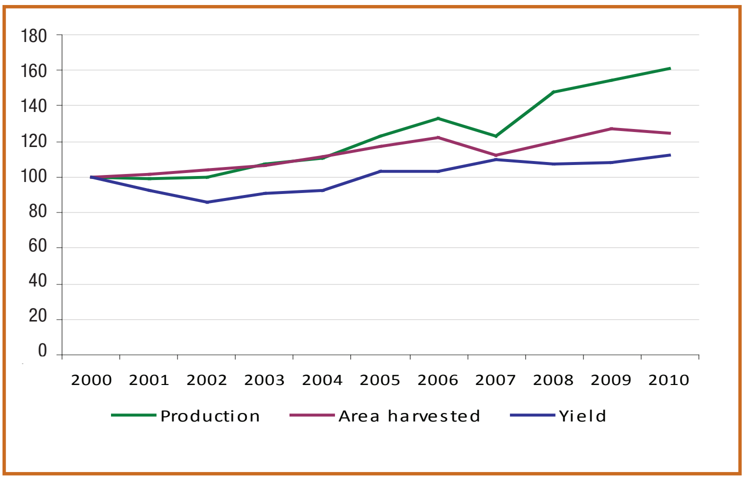

FIGURE 18. Wheat: production (tonnes), area harvested (Ha) and yield (Hg/Ha), 2000-2010, 2000 =100 Source: FAOSTAT

not exposed. Reasons for price fluctuations in rice are explored later in the report, but it is important to keep in mind that nowhere in the world is rice a feedstock for biofuels nor is it linked directly with other crops, like wheat, soybean and maize are linked on international markets.

For wheat, the gap between production and imports is even larger than with rice as during the decade imported wheat ranged between 140% (2001) and 224% (in 2009) of the region's production. In Middle and Western Africa[21], imports of wheat reached the peak of respectively 72 (2006) and 89 (2009) times the quantity of wheat produced (FAOSTAT 2012). As imported quantities are by far greater than local production, it is obvious that Sub-Saharan Africa is heavily dependent on wheat imports from outside the continent. The main wheat exporters to the region are France, Australia, US, Germany and Argentina (FAO 2003a). Local production of wheat has been growing since the mid-2000s, but yields have remained quite stable in the last few years.

Yet despite this exposure to wheat prices internationally and heavy reliance on wheat imports, local wheat prices did not have anywhere near the same increase as they did on the international market, which begs further questions that are explored in more detail later in the price analysis.

21 FAOSTAT geographic grouping: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Saint Helena, Senegal, Sierra Leone and Togo.

Food Prices Analysis

Data and Methodology

The following analysis of African food prices in comparison with international ones uses a similar methodology employed in a study by the International Food Policy Research Institute (IFPRI 2011) that examined food price transmission to local African markets during the 2007/08 crisis. In the IFPRI study, the trends in 83 staple food prices across 12 countries in Sub-Saharan Africa[22] between June 2007 and June 2008 were compared to international prices over the same period; changes in domestic markets were then expressed as a percentage of the change in the corresponding international prices.

The analysis in this paper uses 269 price series of six staple crops – i.e. cassava, maize, millet, rice, sorghum[23] and wheat – per tonne from local markets in 20 Sub-Saharan African countries[24], compiled by FAO (2012) and already converted in US dollars. The 20 countries have been chosen on the basis of the existence of a biofuel industry or a biofuel policy in the country (PANGEA 2011a), as well as the availability of data. The six staple crops examined here have been selected both on the basis of their international price dynamics – especially maize, rice and wheat, and because four of them (cassava, maize, millet and sorghum) are some of the most promising for the production of biofuels in Africa (Aidenvironment 2008).

Local prices are compared to international prices of maize, rice, sorghum and wheat drawn from the FAO's Trade and Markets Division's database over the period starting in June 2010, when global prices dipped, and ending on the month when they peaked – i.e. maize: April 2011, rice: November 2011, sorghum: August 2011, wheat: May 2011. Cassava and millet are not traded on international exchanges and their price dynamics followed different trends than the other crops, hence are analysed individually[25].

> Increases in local prices are less than half the changes in the corresponding international prices for all four crops.

The IFPRI (2011) study used the vector error correction model (VECM) to examine the relationship between world and African food prices. This study does not include any econometric analysis or economic modelling, which gives way to further research on the topic.

22 Cameroon, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Senegal, South Africa, Tanzania, Uganda and Zambia.

23 Grain sorghum.

24 Burkina Faso, Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, Zambia and Zimbabwe.

25 As price dynamics for cassava and millet differ widely across countries, the analysis takes into account the highest percentage increase over the period considered in each country.

Table 1. Changes in African and world food prices (cassava, maize, rice, sorghum, wheat) in 2010/11

Commodity	Period	% change in world prices	% change in domestic prices (in USD)	% change in African prices as % of change in world prices
Cassava	Jul 2010 – Sep 2010	n/a	50.82%	n/a
Maize	Jun 2010 – Apr 2011	95.73%	36.60%	38.24%
Millet	Sep 2010 – Sep 2011	n/a	38.38%	n/a
Rice	Jun 2010 – Nov 2011	52.96%	22.40%	42.30%
Sorghum	Jun 2010 – Aug 2011	94.36%	7.94%	8.42%
Wheat	Jun 2010 – May 2011	78.31%	24.36%	31.11%

Source: PANGEA calculations based on FAOSTAT data

Results and Analysis

Table 1 gives an overview of price trends on world markets and in Sub-Saharan Africa over the 2010/11 period for maize, rice, grain sorghum and wheat. Tables A-1 to A-6 in the Annex give a breakdown of individual countries' price changes, both in USD and local currencies.

A first look at table 1 reveals that food prices have increased much faster on the international scene than in Sub-Saharan Africa's local markets. Increases in local prices are less than half the changes in the corresponding international prices for all four crops. International prices of maize and sorghum almost doubled between Summer 2010 and Spring-Summer 2011, whereas in Sub-Saharan Africa the prices of the two crops rose by, respectively, 37% and 8%. These account for 38% and just 8% of changes in the corresponding international prices. The international price of rice increased by 53% between June 2010 and November 2011, whereas it rose by 22% in Sub-Saharan Africa, the latter being 42% of the former. As for wheat, the average price increase in Sub-Saharan Africa accounted for less than a third of the corresponding increase in global prices. By looking at tables A-1 to A-6 it is possible to observe that price dynamics differed greatly throughout the region, and on the currency in which they are denominated. In fact, high inflation rates are common in Sub-Saharan

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Africa and directly affect the volatility of food prices.

Maize

Patterns in the production of cassava, maize and sorghum described earlier are useful to understand the reasons behind the price changes. The maize harvest of 2010 was the best in the decade and much higher than the previous year's. Still, between June 2010 and April 2011 its price rose by an average 37% in Sub-Saharan Africa.

In Namibia, Uganda and South Africa maize prices rose by 119%, 104% and 71% respectively (see table A-1). Namibia is significantly dependent on maize imports and according to the Institute for Public Policy Research (2011), Namibian maize prices are in fact influenced by international ones.

Uganda is instead a major exporter of maize to neighbouring countries, especially Kenya and South Sudan. A combination of factors determined the dramatic price increase: in the second season of 2010, less than average production was registered due to erratic and early cessation of rains; a drought in Kenya pushed demand for maize; and during the second 2010 season farmers planted less acreage and switched to more profitable crops as a response to the low prices obtained earlier in 2010 (FEWS 2011).

An intentional decrease in production has probably been crucial for South Africa's price rises as well: in the 2009/10 season the country had the largest crop in three decades, with an estimated surplus of about four million tonnes (AllAfrica 2011), while the following crop was predicted to be smaller due to lower plantings (Agritrade 2011).

Rice

Table A-2 shows that Uganda, Madagascar and Mali experienced the highest rise in rice prices. The drought in the Sahel region suffices to explain the upward pressure on prices in Mali, especially concerning imported rice. However the prices did not rise as much as Thai, although Thailand is the main rice exporter to Sub-Saharan Africa, for reasons that aren't entirely clear. The reasons for the increases in Uganda are very likely to be similar to the causes driving maize prices up, i.e. scarce rains and increased demand from Kenya. In Madagascar, droughts led to a 10% drop in rice production as compared to the previous year, which made the price of locally produced rice rise more than the import price (IRIN 2011).

Sorghum

The case of sorghum is curious as while production decreased, prices increased by very little (<8%) and in fact in some of the countries analysed, sorghum prices even fell over the period considered. The highest increases were registered in Senegal, Mali, Burkina Faso and Ethiopia (28%, 28%, 23% and 20% respectively, see table A-3), which is not surprising since all of them have been recently affected by severe droughts.

Wheat

According to table A-4, the country experiencing the highest wheat price increase was South Africa, which imported the equivalent of

67% of its production in 2009 (since 2003 imports have amounted to more than 46% of South Africa's production quantity). Wheat prices in South Africa are however the lowest among the four countries studied. In the Democratic Republic of Congo for example, wheat is 4 times as expensive and the country is heavily dependent on imports (between 16 and 62 times the domestic production between 2000 and 2009). The fact that already high prices in DRC have risen by just 10% may on the one hand prove the low degree of price transmission from international to local prices, but on the other hand may hide local price support mechanisms that this analysis has not analysed in-depth.

As for wheat, the average price increase in Sub-Saharan Africa accounted for less than a third of the corresponding increase in global prices.

The case of wheat is particularly interesting because as it was described previously, the whole region is a large importer of wheat from abroad, namely from France, Australia, the US, Germany and Argentina. One would therefore expect African prices to mirror price dynamics of the markets from which it imports. As a general rule, international maize and wheat markets are closely interconnected as the two crops are close substitutes for animal feed: when maize prices rise, demand for cheaper wheat grows and in turn pushes prices up - and the other way around (ODI 2012). Wheat prices in Argentina and the US have indeed grown by an average 78% as compared to the almost 96% increase in maize prices. The maize-wheat price relationship is instead much less visible in Sub-Saharan Africa, notwithstanding the region's heavy dependence on international wheat markets.

Cassava

The production of cassava followed a gradually growing trend throughout the 2000s. Its 2010 harvest was about the same as in 2009, yet prices rose by an average of 50% in the countries analysed. Uganda and Mozambique registered the greatest price increases among the countries analysed (see table A-5). In Mozambique, about 9,000 hectares of cassava were infected by a virus that destroyed at least 20% of plantations in the southern part of the country (Bloomberg 2011). In Uganda prices rose by 78% between July 2010 and September 2011, but they were still considerably lower (less than half) than in the previous year and the 2010 harvest was slightly higher than in 2009 (FAOSTAT 2012).

Millet

Millet prices rose on average by about 37% between June 2010 and September 2011 and the highest increase was registered in Namibia (60%, see table A-6), which is also, among the countries analysed, the one with the smallest production. In Niger, the largest producer among the countries analysed, millet prices grew by 32%, which is most probably due to the crisis in the Sahel region.

Conclusions on Food Price Dynamics

This paper has analysed the price dynamics of six key staple and potential biofuel crops in Sub-Saharan Africa over the 2010/11 season, during which international food prices rose again to levels comparable to those of 2007/08. A description of the main characteristics of the agricultural sector in Sub-Saharan Africa, as well as of the current state of the cultivation of those crops and of biofuel production in the region has complemented the analysis of price statistics.

The analysis conducted makes it possible to draw important conclusions from the factors behind the high food prices in Sub-Saharan Africa in 2010/11. First of all, the degree of price transmission from international to local markets has been quite limited: price increases in the countries examined were on average lower than the relative rises in global food prices. It is demonstrated by the overwhelming trend among price points in the 20 African countries that when prices soared internationally, price increases were tempered significantly.

In fact, apart from a few exceptions such as Namibia, which is heavily dependent on food imports from abroad, the factors driving up food prices seem to have been strictly local, if the implementation of price support mechanisms and food price subsidies at the national level are not taken into account. In 2011, harvests were lower than in the previous year in all the countries where food prices grew the most, both because of deliberate actions by farmers, i.e. smaller planting as a response to exceptionally good harvests and low prices in the previous season, and for environmental reasons, such as scarce rains and droughts. In the Horn of Africa and in the Sahel region, dramatic droughts have caused famines that have made local prices skyrocket and at the same time increased the demand for food from neighbouring countries, thus affecting their prices as well.

> From the perspective of biofuels mandates in developed countries such as the US and the European Union, this study very clearly shows the disconnect between international prices and local food prices in Sub-Saharan Africa.

In the picture described above, there is very little room to blame biofuels. The production of bioethanol and biodiesel in Sub-Saharan Africa is very limited and is mainly produced from residual molasses from sugarcane, which is already cultivated on a large scale for export-oriented production of sugar and does not directly harm food security. The use of all other crops analysed in this study is still at the experimental stage for biofuels production in the region. In many countries, crops such as maize have been ruled out for biofuel production in order to avoid competition with food.

From the perspective of biofuels mandates in developed countries such as the US and the European Union, this study very clearly shows the disconnect between international prices and local food prices in Sub-Saharan Africa. The numbers demonstrate that though food prices are rising in Africa, it is only a fraction of what is being experienced internationally, meaning that finger-pointing at food insecurity in Africa as a reason to end biofuel mandates in developed countries is foolhardy. When the demand created for additional commodities from biofuels mandates in developed countries is shown to raise international commodities prices, then the fact that Sub-Saharan Africa is predominantly shielded from that price instability must be highlighted. That lack of price transmission is key to understanding the real dynamics in the food and fuel competition debate so that the true drivers in food prices can be analysed and addressed. Continually blaming biofuels, however, will only serve to create discomfort in the global investment community and keep true economic development from reaching the continent.

So if not biofuels, why is there food insecurity in Africa?

This report has demonstrated the disconnect between biofuel mandates in developed countries and rising food prices in Sub-Saharan Africa. But the lack of relationship between biofuels and food prices does not negate the fact that food insecurity remains a key factor in poverty across the continent.

Poverty is a multi-faceted phenomenon, but one unquestionably clear result is hunger. No continent has had a starker picture painted of itself by chronic hunger and famine than Africa. Over the past few decades, aid to Africa has focussed on cutting poverty rates, encouraging economic development and nurturing increased education rates. This programme of aid has created positive headway for investment generally speaking, though its effects on total productivity may have diminished. Aid is not always seen as a positive force. A recent development study (Alvi & Senbeta 2012) found that the effects of aid were contradictory, boosting investment but diminishing total productivity, particularly through lower rates of efficiency within the economy and of financial institutions to support productivity growth (Alvi & Senbeta 2012).

Nonetheless, development aid to the continent has increased by 250% since the 1980s, but the allocation to agriculture has halved (Bragg *et al.* 2010). This lack of increased investment in agriculture is evident in the failure of many countries to meet their development targets, and for the poorest sectors of society to meet basic food and hunger needs. The backdrop to this is that agricultural yields remain very low compared to the global average, roughly one third as high on average at 1.1 tonnes per hectare in Sub-Saharan Africa (SSA) compared to 3.2 tonnes globally during 2008-10 (Rousen & Shapouri 2012). What is more, one third of the 39 SSA countries showed a decline in yields between 2000-2010 (Rousen & Shapouri 2012).

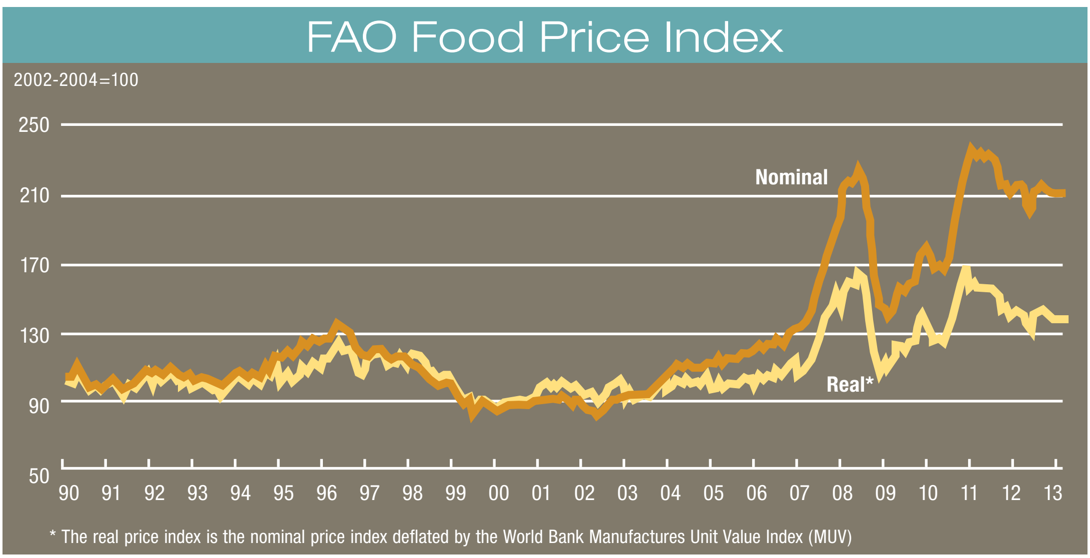
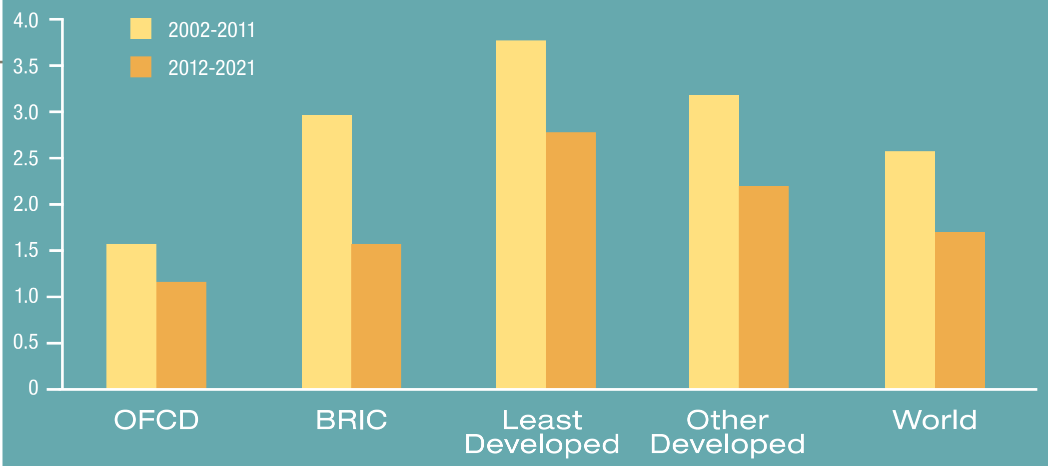


FIGURE 19. – FAO Food Price Index, showing spikes in recent years. FAO 2013.



BRIC: Brazil, Russian Federation, India, China

Note: Net output is measured as production less seed and feed and valued at 2004-2008 prices for production of primary commodities in this Outlook.

FIGURE 20. – OECD - FAO outlook for global agricultural growth OECD & FAO. 2012

There are many drivers of food price and food availability and these drivers are wide-ranging. Food price is a function of the same market forces at play across a range of commodity markets, but perhaps more susceptible to various shocks—particularly climatic shocks. Climatic shocks such as drought and flooding can be both short and long-term. Weather extremes are likely to become the norm if models for global climatic change hold true, over the long-term (Dewar 2012; Dinar *et al.* 2012). Also over the long-term, population trends and competition for food is likely to increase, which will drive up demand, and subsequently affect price. Developing country consumers are less able to adjust for rising prices as easily as those in stronger economies, partly why it is thought hunger will persist. In SSA most consumers spend more than 50% of their income on food. In OECD countries commodity prices do not translate as obviously to consumer prices thanks to a high proportion of processed food (Schafnit-Chatterjee 2011) in the market. This safety net is largely not present in SSA, exacerbating food waste problems.

The UN's number one Millennium Development Goal (MDG)—to eradicate extreme poverty and hunger by 2015—will not likely be achieved in Sub-Saharan Africa. The recent progress assessment report states there is still very high poverty across SSA coupled with very high hunger rates (UN 2012). On a country-by-country basis, there has been some success. The World Bank in 2009 (despite price spikes in 2008) identified Egypt, Ghana and Mauritania as on track for achieving MDG 1, with a list of 24 SSA countries on track for halving hunger by 2015 (World Bank 2009). Most of the progress in this vein was achieved before 2007/08 and has since levelled off (FAO 2012). This is likely due to food prices rising sharply in 2008, and then again in 2010/11 (see *fig. 19*), contributed to by simultaneous rising energy prices and a global economic downturn.

This report will now examine the present situation of food availability, price, prognosis for production now and in the next few years, and how changing demographics in both the economic and social arenas are likely to — and have already — affect the purchasing power of African populations. The findings of this report do not point to a lack of food availability, but more to a lack of purchasing power for, in particular, smallholder farmers.

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This segment of society has since 2008 (FAO 2013) been faced with long lasting and higher-than-average prices for seeds and energy. This has a knock-on effect further down the chain for consumers struggling with consistently low incomes but increasingly long-term price hikes for food (see *fig. 22).* These effects have been felt at the household, community, village, regional and national levels.

Changing demographics

High rates of population growth in Sub-Saharan Africa, which are expected to range from between 1.6% to a touch over 2.4% on an annual basis between 2010 and 2050 (Thomas & Zuberi, T 2012), will make the MDGs hard to achieve and a challenge to maintain. During this period Africa is set to hit 2.3 billion inhabitants up from a current level of 1.1 billion (Sporton 2012). These challenges are surmountable, but if allowed to continue unchecked will wholly undermine development in the region.

The rural-urban population split demonstrates a more recent and emerging demographic revolution, one that will have an impact on local food markets. It shows an increasing move away from traditional smallholder farming community structures, especially among men, to urban areas. This not only has implications for the burden of labour falling to women, who overall are estimated to account for 43% of total farmers worldwide (Conway & Wilson 2012), but also on incomes flowing back to rural communities.

Small farmers feed the continent

Despite the progress over the last few years, the fact remains that 1 billion people in the world today are

Table 2. The fastest growing economies by GDP. (IMF 2010)

2001-2010		2011-2015 (IMF forecast)	
Angola	11.1	China	9.5
China	10.5	India	8.2
Myanmar	10.3	**Ethiopia**	**8.1**
Nigeria	**8.9**	**Mozambique**	**7.7**
Ethiopia	**8.4**	**Tanzania**	**7.2**
Kazakhstan	8.2	Vietnam	7.2
Chad	**7.9**	**Congo**	**7.0**
Mozambique	**7.9**	**Ghana**	**7.0**
Cambodia	7.7	**Zambia**	**6.9**
Rwanda	**7.6**	**Nigeria**	**6.8**

going hungry, with 98% living in developing countries (Conway & Wilson 2013). What is more startling is that 70% of people who are classed as chronically hungry are smallholder farmers (Conway & Wilson 2013), the very population group that is producing food. Smallholder farmers are a particularly vulnerable group of people, but also a particularly large group in Africa. Some half a billion Africans, 65% of the population in total, touching even 80% in some countries, depend on small-scale farming as a primary source of livelihood (Bragg *et al.* 2010). Roughly 80% of this number farm less than 2 hectares of land.

It is this element of the population that forms the building blocks of much of the continents' economy, feeding the surrounding communities from small 1 or 2 hectare farms. Yet, while a crucial and large percentage of the population, smallholder farmers are the least resilient and most vulnerable portion of society in many countries. Two-thirds of this group are classified as 'chronically hungry' (Conway & Wilson 2012). This inconsistent paradigm underlines the skewed nature of incomes in Sub-Saharan Africa.

Growth but no development

In the face of record levels of food prices, which it is generally agreed are unlikely to fall back to pre-2008 levels in the medium- to long-term (FAO 2012a), agricultural production in Africa has seen growth of 3.4% per year from 2001-2010 (Diao *et al.* 2012). This outpaced Africa's population growth of 2.5%. Agricultural growth in net output on average is projected to slow down as they move into the 2012-21 decade from the previous (see *fig. 20).* It is expected that Least Developed Countries (LDCs), including a large number of SSA states, will see higher average rates of growth in output than developed nations at over 3.5% from 2002-11, above the world average of just over 2.5% for the same period.

While agricultural growth looks to remain relatively strong, GDP growth in many SSA

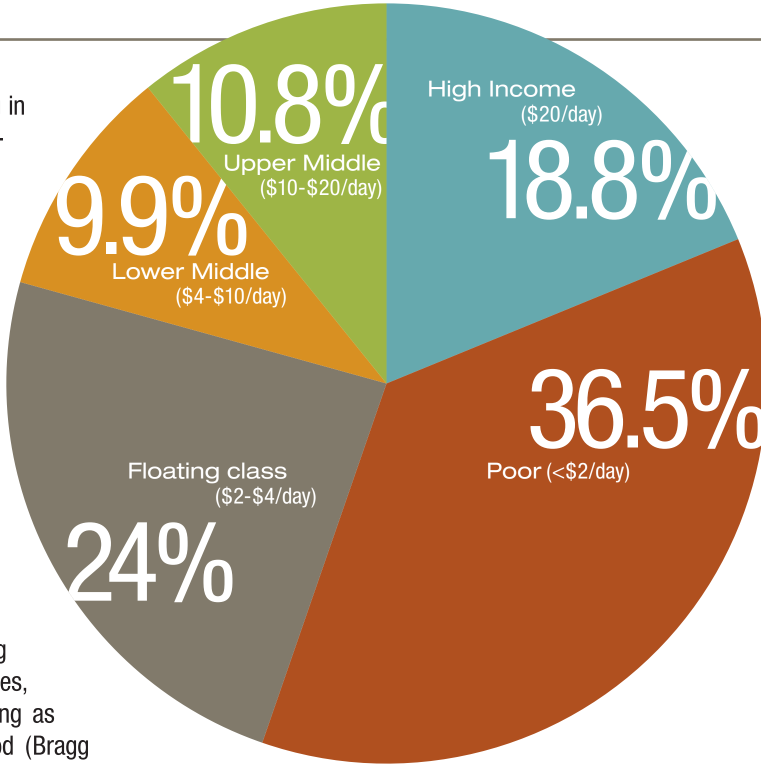

FIGURE 22. Breakdown of incomes in Africa. AfDB 2011

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countries is exceptionally strong, achieving an average of 6% growth across the region (The Montpelier Panel 2012). Angola tops the growth rankings from 2001-2010 with an average rate of 11.1%, lying ahead of China (Livingston *et al.* 2011) (See *Table 2*). Other SSA countries feature in the top 10 fastest growing economies for the same period; Nigeria, Ethiopia, Chad, Mozambique and Rwanda, with figures varying from 8.9% (Nigeria) down to 7.6% (Rwanda) (Livingston *et al.* 2011).

Forecasts for economic growth over the next four years (see *Table 2)* count seven SSA countries among the top 10, with Ethiopia and Nigeria present in both top 10 rankings (Livingston *et al.* 2011).

GDP growth rates remain robust in many SSA countries, with median GDP per capita (PPP adjusted), growing between 2007 and 2010 from US$1,315 to US$1,610 (Tortura 2011). The percentage of the population in a Gallup poll in stating that they were "getting by on present income" was 16%, nearly half the amount saying the same in 2007 (Tortura 2011).

This again outlines the effect of squeeze on the system. Income levels for the region are the lowest to be found anywhere worldwide.

The heart of food insecurity

As outlined in the previous sections, there are many pressures facing communities in Sub-Saharan Africa, but research has highlighted a positive outlook for food production in that productivity can increase. However, there remains a large portion - some 30% of the population of Africa in 2005 (FAO 2008b) – living in hunger. Progress in this area likely reduced following two price spikes, particularly in 2008 (see *fig. 19).* This shows the large disparity between a buoyant picture in the agricultural industry at odds with persistent levels of hunger.

Food insecurity persists in the face of a continent abundant in natural resources. Categorically put; "if the food available in Sub-Saharan Africa were evenly distributed, all Africans could consume enough calories for basic functioning" (UNDP 2012). This is before mentioning food waste, which a report with this scope cannot hope to examine in depth, though postharvest losses are examined in another section. Access to food and abundance of food waste underline the fact that incomes remain cripplingly low for the majority of the populace despite availability of food. A breakdown of incomes in Africa is shown in Figure 22.

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Table 3. Price volatility of selected staples (Naylor & Falcon. 2010).

Commodity	1970-1979	1980-1989	1990-1999	2000-2009
Rice	44	43	14	49
Wheat	36	24	21	32
Maize	25	27	20	29
Petroleum	69	41	25	46

Monthly variation in selected real commodity prices, by decade (coefficient of variation, percent)

Souce: Naylor an Falcon, 2010. p 696

Table 4. Proportion of income spent on food (Depetris et al. 2012).

Country	National	Urban	Rural	Poorest Quintile	Richest Quintile
Benin	56	54	57	59	52
Burkina Faso	62	52	65	74	45
Burundi	57	60	57	54	53
Cameroon	63	55	68	68	53
Côte d'Ivoire	55	56	54	58	45
Ethiopia	70	57	75	82	52
Gambia	68	67	69	69	67
Ghana	62	58	64	66	58
Guinea-Bissau	70	64	72	69	64
Kenya	73	57	77	83	56
Madagascar	84	76	86	84	77
Malawi	59	57	59	58	56
Mali	62	54	66	64	55
Nigeria	72	70	75	84	62
Rwanda	56	57	56	77	31
Senegal	57	53	61	62	48
South Africa	40	34	50	58	16
Tanzania	85	86	85	90	76
Uganda	65	44	69	70	50

Source: Depetris Chauvin, Mulangu, and Porto 2012

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Yet while a crucial and large percentage of the population, smallholder farmers are the least resilient and most vulnerable portion of society in many countries.

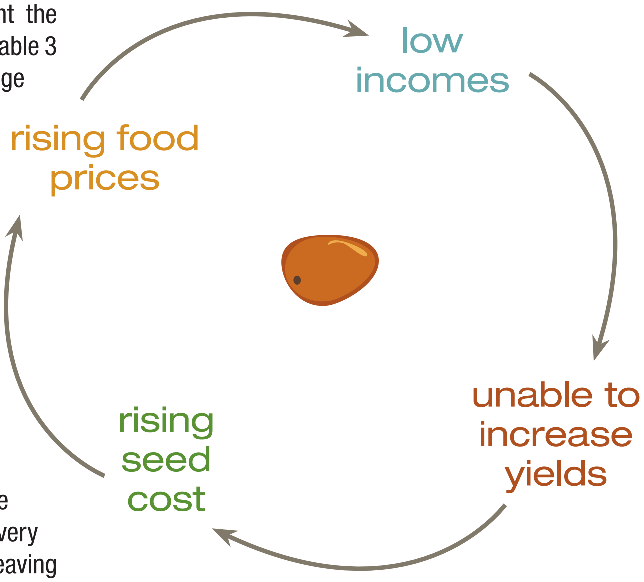
A study by the African Development Bank shows that just over one-third of the population in Africa lives on less than US$2 per day, with a further 24% of the population living on US$2-4 per day (AfDB 2011). This segment of society as a whole has struggled for decades to afford even more-modestly priced staple foods. But as outlined by UNDP, there is no lack of food availability across the region. The problem is localised, with some regions such as the Sahel and the Horn of Africa suffering from a lack of infrastructure, access to markets, and in many cases, geopolitical instability and corruption.

While the figures in Figure 22 highlight the amount of income that is common in SSA, Table 3 outlines the variability of prices across a range of consumables from 1970 to 2009. This starkly presents the scale of variability in price for daily essentials that hits the more vulnerable lower income groups the hardest. Importantly, Table 3 shows the increased price volatility over the last decade.

It is clear from this table that incomes need to be improved if the vulnerable smallholder farmers are to be able to cope with climate or political shocks, or in an ideal world, develop their farms and successfully raise and educate a family. Food accounts for a very large proportion of household incomes, leaving little for buying seeds and fuel (see *fig. 24*). This probably accounts in no small part for the low rates of fertiliser utilised in SSA.

Low incomes severely damage the chances that households will be able to cope with the volatility in food prices shown in Table 3, and knock-on effects can have long-lasting economic and socially detrimental effects. The links are far-reaching and beyond the scope of this study.

In brief, the deficiencies caused by low incomes, when the cost of food as shown in Table 4 accounts for more than 50% of the household income, means the following crucial factors suffer such as nutrition. Malnutrition can be especially damaging in childcare and has long-term effects on the inability to cope with environmental stress or shocks through



increased time-intensive nursing and potentially using more income to pay for medical care. A lower income means fuel for cooking is more difficult to afford and further compounds the problem of nutrition.

Perhaps most crucial of all the effects low incomes can have on households is the squeeze on agriculture. The pressure on incomes increases as food prices rise, as Table 4 shows. Incomes are further squeezed by the cost of seeds for growing crops and raising livestock. This process is cyclical as without the optimum, the most in demand and expensive seed varieties become unavailable to smallholders, leaving farmers unable to increase yields and production.

There are solutions to this destructive cycle. The food is available in Sub-Saharan Africa to feed the population. With strong growth in gross domestic product in much of the region, a further look at investment in infrastructure is necessary. Much less costly policy decisions can have far-reaching beneficial effects as well. Investment in agricultural infrastructure such as storage, processing facilities and roads will negate the need of farmers to 'sell low' at harvest time and 'buy high' during the lean season thus evening out consumption (Lipton. 2005). Storage would mean that crises are at least "less-likely" and would lessen calls for international aid. Each investment in infrastructure will bring in more resilience to the system.

"A 1% gain in GDP originating from agriculture will generate a 6% increase in overall expenditure of the poorest 10% of the population; in contrast a 1% gain in GDP originating from non-agricultural sectors creates zero growth"

(Conway and Wilson. 2013).

The UNDP has laid down some excellent recommendations for policies that will boost agricultural productivity while tackling the income problem head-on. The recommendations are simple and highlight the inextricable link between income and smallholder agriculture. These range from encouraging adoption of sustainable agricultural inputs to stabilising trade and use of fertiliser, seeds and water (UNDP 2012).

Thees simple measures would shore up the lack of resilience in local economies and balance out the effects of global price volatility. The use of mobile phones, as outlined previously, could be pivotal in giving distant farmers a voice with which to make recommendations and to place orders for seed and fertiliser, etc.

The UNDP 2012 report outlines the benefits of investing in the financial infrastructure of the agricultural markets, such as credit and insurance. There is a strong area of possible growth in micro-credit and micro-insurance schemes for smallholder farmers who have traditionally been left out of these tools that can increase resilience to shocks. Physical infrastructure can also have a positive effect on bringing down food prices in areas where production has been lower.

Perhaps the most simple and yet most effective of all the measures outlined in the UNDP's 2012 report is to enhance the creation and application of local knowledge through agricultural extension programmes. This, it says, would improve seed resilience, engage the youth, and be more inclusive for women (UNDP 2012).

Impacts of agricultural subsidies on African food security

Another driver contributing to global food price increases having a direct impact on food prices in developing countries are the agricultural subsidies implemented by developed ones. Such subsidies interfere with price mechanisms that would ordinarily determine commodity prices. Agricultural subsidies often lead to lower food prices in the short-term, however, this section examines how, in the long-term, they can contribute to high global food prices.

The global food market for staple foods has been distorted for farmers in developing countries through subsidies distributed predominantly from the European Union and United States governments through instruments such as price support and producer subsidies (IFPRI 2012). The subsidised crops grown in these regions are exported, putting downward pressure on world food prices and in turn making small holders less competitive, reducing global food production over the long-run, leading to food insecurity, and therefore, sustained price rises.

Subsidies employed

There are a range of subsidies that encourage inefficiencies in the agricultural sector. Price control measures can prevent farmers from responding to market signals, distorting trade and encouraging over-production (ICTSD 2011). It is the subsidies that encourage over-production that cause the most damage to poor countries as the surplus commodities depress world prices (ICTSD 2009).

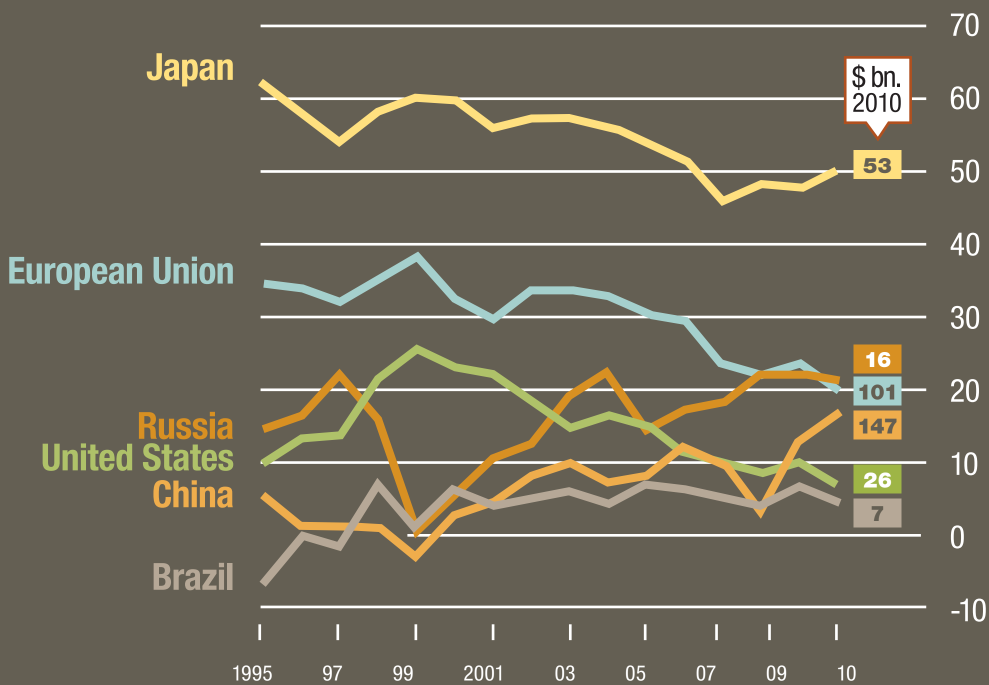
Other subsidies can include non-financial regulatory

Table 5 Choice of subsidy options over short, medium and long-term

Short-term policy	Medium-term	Long-term
Tariffs/ Taxes	Short-term policies	Short-term policies
Consumer subsidies	Food price stabilization policies based on the use of reserves and/ or subsidies	Medium-term policies
Export restrictions and Government food imports	Provision of agricultural support services and producer price supports	Investments for economic development
Food price controls and release of public reserve stocks	Extend social protection programs to maintain food consumption	Investments for poverty reduction

Source: IFPRI 2008

FIGURE 25 Agricultural Subsidies: Estimated producer support as % of gross farm receipts



Economist (2011)

instruments, though these tend to be supplemented by financial measures (World Bank 2009). Losses that are made to satisfy price objectives can be seen as direct subsidies (Boto, I 2011).

Where the production cost becomes higher than the sale price of the goods on the international market, there is downward pressure on prices. That negatively impacts the competitiveness of developing countries and therefore undermines their domestic production potential as they attempt to compete on an egalitarian basis with cheap imports of all kinds—not just commodities, and not just those that could be used as biofuel feedstocks. The subsidies granted by the EU, for example, have in the past decreased the cost of wheat by 30-35% and sugar 60-75%, while in the U.S. maize is lowered by as much as 35% and cotton (production linked to food prices through use of shared resources) can range from 20-55% lower[26]. Combined, the investment of the EU and U.S. in agricultural subsidies nears US$350 billion annually[27]. Charities such as Oxfam and ActionAid have argued that the terms of the WTO benefit the markets of the U.S. and the EU[28] to the detriment of the developing countries (IFPRI 2012).

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26 ActionAid 2003
27 Comciencia 2003
28 Ibid

>>> from page 39

EU Subsidies – an introduction

In the EU, agricultural subsidies are dispersed to farmers through the Common Agricultural Policy (CAP) that was created in post-war Europe to stabilise farm income and keep food prices affordable. Roughly 5% of its population are employed by agriculture and the EU spends nearly half of its budget on subsidies in the sector[29], totaling nearly €60 million annually[30]. Sourced from the EU Commission budget, three-quarters of the budget goes to direct payments for farmers with the rest spent on improving structural and environmental aspects along with development, both local and rural[31]. The Overseas Development Institute (ODI) (2011) identifies Africa and South America as regions heavily affected by the CAP, sugar and dairy being areas heavily affected[32].

US subsidies – an introduction

The Agricultural Act of 1949 provided protection to dairy, meat and crops and expired in 2001. The 2002 Farm Act renewed support for the agricultural sector providing approximately US$16.5 billion in subsidies annually. The Act was extended in the form of the Food, Conservation and Energy Act of 2008. The American Taxpayer Relief Act of 2012 (Government Printing Office. 2013), or the "Fiscal cliff" deal, has extended the principles of the 2002 Farm Act through to September 2013 while new legislation is negotiated.

The central criticism of US agricultural subsidies is that large-scale producers benefit most, having a significant negative impact on African farmers getting a reasonable price for their crops (Government Printing Office. 2007). In 2008 African leaders made specific reform proposals for agricultural subsidies to which the US has so far failed to respond[33].

Figure 25 shows the decreasing trend of agricultural subsidies as a percentage of farm receipts for the EU, while the US is harder to predict. Government support from the wealthy OECD countries dropped to 18% of farm receipts in 2010, the lowest since 1986. However, agricultural support has increased in several emerging markets, the most notable of these is China, rising to 17% in 2010 (Economist 2011). Therefore it may be in emerging markets that future agricultural subsidies push future prices up over the long-term.

Dumping

Wealthy countries use billions for agricultural subsidies, leading to on-going overproduction and the 'dumping' of surpluses on global commodity markets; this serves to impoverish small-scale producers, simultaneously rewarding large-scale producers[34].

Dumping weakens small-scale producers as products are sold below production cost (to grow the market share of the large business). This imbalanced competition damages the domestic industry (Sharma, 2002). The effect of this can collapse developing agricultural markets, leading to the demise of family farms and therefore heightened food insecurity[35].

An example of this phenomenon is the case of the Mexican maize industry where subsidised US exports drove the price down by 70%, encouraging

29 Global Policy Forum 2011
30 European Union 2012a
31 Tran, M. 2011
32 Comciencia 2003
33 Kinnock, G, 2011
34 Global Policy Forum 2005
35 Moore, M. 2002

Table 6 WTO Subsidy classifications

Green Box	Amber Box	Red Box
This is a permitted subsidy, judged to not distort trade, or at worst cause minimal distortion. These subsidies must be government-funded and must not involve price support.	These subsidies should be reduced. For agriculture, all domestic support measures considered to distort production and trade (with some exceptions) fall into the Amber Box.	Forbidden subsidy, considered to excessively distort trade.

Source: WTO 2004

Mexico to import this commodity from the US, and as the price was often lower than the cost of production, a large amount of small-scale producers invested less in their domestic industry[36]. The current maize price is steadily increasing now as can be seen in the statistical analysis.

Small-scale commercial poultry producers have claimed that hundreds of thousands of jobs in the sector were lost in West Africa (FAO 2010a) due to unwanted subsidised chicken parts (often frozen) being exported to Africa. In Cameroon more than 110,000 jobs were lost between 1996 and 2003, and chicken production fell by nearly 40% between 2000 and 2003[37]. This heavily impacts small holders' livelihoods in the poultry trade and rural households in developing countries of which approximately 80% produce poultry on a small-scale (FAO 2010a).

Insurance

Most agricultural insurance programs receive some form of subsidies (FAO 2009). The nature of agricultural risks means insurance premiums are high – and as such many farmers can only afford insurance with subsidies[38]. In the US, by and large farmers only pay 40% of what the unsubsidised premium would be (ILRI 2012), while insurance-based subsidies have increased to US$5.6 billion in 2011 from US$400 million in 1990 (ICTSD 2012). Farmers who have subsidised insurance have an advantage over farmers that are without because they are protected against external shocks.

The EU has a similar scheme – through fixed income support that is effectively, though not explicitly, insurance. Crop insurance is provided by the development scheme but pays out when losses are more than 30%, therefore classified by the WTO as 'Green Box' while the US lies within the WTO's 'Amber box'.

Between 2007 and 2011, insurance formed 21% of the US farm subsidies that are expected to rise proportionally. Roughly US$9 billion per year will likely be spent in the next decade (ICTSD 2012). Heavy research is being conducted to find a way to overcome the challenge of insuring small-scale farmers[39].

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36 Comciencia 2003
37 Nguedjio, S.K. 2005
38 IFAD & WFP 2010
39 Boto, I. & Lopes, I. 2012

>>> from page 41

Non-tariff trade barriers

Food health and safety requirements can differ considerably from country to country, especially in the case of developed and developing countries (Dong & Jensen 2004). Technical, regulatory and administrative requirements can constrict developing-countries especially in the context of high-value agricultural exports, influencing international competitiveness (World Bank 2005).

The EU imposes rules on hygiene, pesticide residues, additives and animal welfare among others, often utilising labelling and quality logos[40]. EU farmers receive high subsidies to meet such strict standards, disadvantaging farmers in developing countries who are left to compete in an unfair market but who also lose income in trying to comply with the standards to export to the EU[41].

In the fish industry, developing countries must meet different regulatory and technical standards to export to the US, EU, and Japanese markets (Henson, Mitullah 2004). In the poultry industry there are an array of process standards to limit the risk of salmonella (Mathews, *et al*. 2003) and there is a restriction on the aflatoxin levels in cereals and nuts, restricting African trade to the EU (Otsuki, et al. 2001).

The difference in assessment standards increases production and transaction costs for suppliers in developing countries, reducing their capacity to achieve economies of scale for safety standards and therefore production (World Bank 2005).

Financial support

There are many ways countries can support their farmers with financial measures, including subsidised interest rates on loans, offering market price support, making direct payments; all of which can be linked to preventing developing countries from advancing their agricultural sectors[42]. Furthermore they can stop farmers from responding to market signals from consumers[43].

Between 2007 and 2011 direct income payments made up approximately 50% of U.S. farm subsidies, however this amount is expected to fall in the future (ICTSD 2012).

Trade barriers

Agricultural trade barriers are sometimes used in tandem with subsidies and can have equally harmful effects on trading partners (FAO 2008a) by depressing local food prices while driving up global food prices[44]. A great example of trade restrictions affecting world food prices is the spike in rice prices from 2006-2008; trade restrictions were responsible for almost half the increase (Economist 2012b).

Developing countries are not immune to this effect. Even though most countries in Africa don't have the financial capacity to offer subsidies except in limited cases, these trade barriers between countries and regional economic communities (RECs) can also have a negative effect. For example, trade barriers prevent access to improved modern seeds; in some cases countries have advanced seeds but neighbouring countries use old ones because trade barriers prevent transfer. This is the case in Ethiopia where hybrid maize could help quadruple productivity if they had access to the product. It is estimated the use of these seeds would increase domestic production enough to replace imports (Alemu 2010).

40 European Union 2012b
41 Brussels Briefings 2009
42 Boto, I. & Lopes, I. 2012
43 Boto, I. & De Gioia, A. 2012
44 CTA 2011

By creating a fairer and more transparent trading system it will favour a better allocation of resources over the medium-term, particularly for developing regions that enjoy a comparative advantage, garnering food security in the medium-term[45].

trade liberalisation would increase prices in the short-term by 10% for cotton, 15% for oil seeds and overall 5% for primary agricultural products (Wilson, 2012). Higher food prices as a result of this would benefit non-subsidising countries (FAO 2003b).

Long-term impact of subsidies on global food prices

To establish the impact of subsidies, it is important to differentiate between general subsidies for all farmers and targeted subsidies. First, the price elasticity of supply needs to be determined to show how much over-production occurs from the subsidy scheme. The net impact of the subsidies on producers in the developing world depends on the strength of these effects in relation to the pressure on commodity prices (IFPRI 2008) as a result of increased production.

FAO figures place 70% of people in developing countries as dependent on agriculture for a living, generating 26% of GDP. When compared to the developed world's 5% of labour force and 2% of GDP,[46] it is clear that the developing world is more exposed to shocks in this sector. Subsidies to OECD countries is estimated at 22% of the total receipts of agricultural producers (OECD 2010b) at US$250 billion a year, 70% of which is damaging to developing country producers. The EU is responsible for 38% of distortions while the US is responsible for 16% (Wilson 2012).

The WTO has appealed to the US to cut farm subsidies as they affect production and market prices[47]. The World Bank predicts that complete

45 Pène, C. 2011
46 Comciencia 2003
47 Agence France Presse 2010

Subsequent effects on agriculture in developing countries

Quantifying the impact of a subsidy is problematic, even when there is accurate data on government expenditure; there are often issues in identifying this as farm income, input supplier income, or whether it is spent satisfying bureaucracy (FAO, 2004).

However, estimates place the impact of subsidies in developed countries as reducing small country agricultural income by as much as 10-15% (Diao, *et al*. 2003) and Mitchell (2004) attributes the decline in sugar exports from developing countries to 54% from 71% between 1980 – 2000, in part, to increased agricultural support in the developed world. In 2002 the United Nations Development Program (UNDP) estimated that the agricultural subsidies from the EU, US and Japan cost developing countries nearly US$50 billion a year in lost earnings[48] and in 2003 IFPRI estimated this to be US$64 billion a year through protectionism and trade distorting measures (IFPRI 2003).

More research is required on how agricultural subsidies promote over-production leading to higher food waste levels, and whether or not this can be controlled with legislation[49].

48 Kristof, N. 2002
49 Hodges R.J., Buzby J.C. and Bennett B. 2010

The challenge of postharvest losses

When it comes to African countries, nutrition remains one of the main deficits, and food price crises are not the only concern; price volatility, the risk of food shortages, the effect of EU and US agricultural subsidies and the low-income of most of the African population also need to be considered. An additional, often forgotten, factor that increases food insecurity comes from postharvest losses (PHL). PHL occur throughout the chain, reducing real income for producers, traders, and consumers. This especially affects the poor as such a high percentage of their disposable income is devoted to staple foods.

FAO (1994) defines "postharvest losses" as a measurable quantitative and qualitative loss in a given product. These losses can happen in any of the postharvest phases, which are identified as harvest, handling, threshing, drying, storage, packaging and transport.

Losses are not only physical, but they can also be nutritional, such as contamination of grains, as well as being monetary and economic because they can not be sold on certain markets, for example (World Bank *et al.* 2011). Quality losses are one of the main barriers to access in international markets.

An FAO 2011 report (FAO 2011c) on PHL indicated that the bulk of food losses in OECD countries occur largely at the consumption stage, while most losses in Africa are due to poor processing, handling and storage. The report esti-

Table 7. Estimated Postharvest Losses (%) 2003-2012

Weighted average according to reported figures

Regional total PHL for cereals (% of total annual production)

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
14	14.9	14.1	14.7	15.4	14.1	13.8	13.8	14	14.5

Regional PHL by cereals (% of total annual production)

Cereal	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Wheat	5.8	5.5	11.4	9	9.7	4.3	9	10	9.4	12.5
Maize	16.8	17.4	17	17.8	18.2	16.4	16.5	16.5	16.7	18.1
Rice	11.7	11.7	11.6	11.7	11.7	11.5	11.5	11.5	11.5	11.6
Sorghum	12.3	11.9	12.1	12.3	12.1	12.3	12.4	12.4	12.4	12.4
Barley	9.8	4.9	9.2	9.2	9.2	-	9.8	9.8	9.8	9.8
Oats	-	-	2	2	2	-	2	2	2	2
Millets	10.4	10.5	10.5	10.6	10.9	10.2	10.2	10	10.1	10.5
Teff	11.7	11.7	11.7	11.7	11.7	-	11.7	11.7	11.7	11.7

http://www.aphlis.net/index.php?form=losses_estimates

Table 8. Estimated value of weight losses for Eastern and Southern Africa based on annual production and estimated % PHL, 2005-07, average

	Production for 16 countries of Eastern and Southern Africa (million tonnes)	Average local prices	Estimated value of production (US$ Million)	Regionally estimated average % weight loss	Value of weight losses (US$ Million)
Maize	27.01	194.71	5,528	17.5	920
Sorghum	4.72	250.02	1,181	11.8	139
Millet	1.87	305.34	510	11.7	60
Rice (paddy)	5.15	405.53	2,089	11.5	240
Wheat	5.25	274.36	1,441	13.0	187
Barley	1.71	281.53	481	9.9	48
Total	**46.18**		**10,960**		**1,594**

Note: *Countries included are Botswana, Eritrea, Ethiopia, Kenya, Lesotho, Madagascar, Mozambique, Nambia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe.

** Average producer prices from FAOSTAT.

Source: Calculations based on FAOSTAT and APHLIS data

mated postharvest grain losses in SSA reach about US$4 billion a year.

PANGEA strongly believes that PHL is one of the main drivers of the food crisis in Africa, however this topic is often avoided in reports blaming biofuels as the main cause of food price crises.

The identification of postharvest losses as one of the causes of food insecurity is not new. The problem was first addressed at an international level by the then US Secretary of State Henry Kissinger in 1974 at the World Food Conference[50], referring to it again later at the 7th Special Session of the UN General Assembly in New York. The same year, a resolution of the UN General Assembly on PHL was passed stating that "The further reduction of postharvest losses in developing countries should be undertaken as a matter of priority, with a view to reaching at least 50% reduction by 1985. All countries and competent international organisations should cooperate financially and technically in the effort to achieve this objective" (World Bank *et al*. 2011).

In 2006 and 2010, the African Union (AU) food summit resolutions brought back the issue of postharvest losses to the policy agenda. These resolutions from AU Food Summits held in Abuja re-echoed the earlier UN Resolution, which was again confirmed at the 11th Ordinary Session of the African Union in Sharm El Sheikh in 2008, where they committed to

50 Bourne. 2011.

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improve postharvest management to minimise agricultural losses and enhance value addition. Countries such as Rwanda have developed a 'National Postharvest Staple Crop Strategy' and set up a task force to reduce postharvest losses to 15% from 23%, especially for maize, rice and beans.[51]

Postharvest losses are also present in recent global initiatives, such as the Comprehensive Framework for Action issued in 2009 and updated in 2010[52] by the UN High-Level Task Force for Food Security and Nutrition after the global food crisis, the Global Agricultural and Food Security Program,[53] endorsed by the World Bank in January 2010. The recently reformed Committee on World Food Security (CFS)[54] also includes PHL reduction in its work.

According to the World Bank (World Bank *et al*. 2011), more than 25% of food grains (cereals and food legumes) produced by farmers never reach the final consumers as a result of postharvest losses. These losses are even more dramatic with respect to less hardy and fleshy root crops (cassava, yams, arums, potatoes), tropical fruits and vegetable crops where more than 50% of farmers' produce never reaches the final consumer. FAO (FAO 2011b) has recently showed that global food losses and waste for cereals stand at roughly 30% for root crops and fruits and vegetables, 40-50% for oilseeds, 20% for meat and dairy, with fish losses at 30%.

These losses have a negative effect on the income of farmers, especially in developing countries, where investments in crop plantations will not be totally repaid in production. PHL also contributes to high food prices by removing part of the food supply from the market (World Bank *et al*. 2011). Considering the previously mentioned statistics, it seems clear that postharvest losses are responsible for a large part of food insecurity in Africa, to a much larger extent than the claims being made against biofuels production.

Poor farming practices and infrastructure are the main causes of PHL as these are related to storage, processing and packaging problems. Losses that occur in the phases prior to harvest, for example because of poor quality seeds or insect infestations, are not consid-

> An FAO 2011 report (FAO 2011c) on PHL indicated that the bulk of food losses in OECD countries occur largely at the consumption stage, while most losses in Africa are due to poor processing, handling and storage. The report estimated postharvest grain losses in SSA reach about US$4 billion a year.

51 African Union 2012
52 UN High Level Task Force on the Global Food Security Crisis 2010
53 GAFSP 2012
54 CFS 2013

ered in this report. The dearth in good quality storage has a highly detrimental effect on food production levels, with most estimates attributing a loss of 15-20% of all cereals to post-harvest losses and a still larger amount to perishable goods (World Bank, National Resources Institute & FAO 2011). The importance of storage and cleaning of produce cannot be underplayed, especially for staples such as cereals, where mould can wipe out tonnes of supply at a time. Proper drying and storage needs to ensure moisture levels of around no greater than 13-15% (World Bank, National Resources Institute, & FAO 2011), an activity that is hugely reliant on access to energy. This requires far-sighted investment in agricultural infrastructure.

Regarding quantity losses, the African Postharvest Losses Information System (APHLIS)[55] identifies two main reasons; firstly, losses occur when grains are scattered, dispersed or crushed mainly during the phases of harvesting, processing and transport, while the second reason is the biodeterioration of grains, mainly caused by weather conditions and pests.

It is difficult to quantify losses, mainly because PHL derives from different factors in different regions. In fact, losses can change in relation to season, variety of grains and the circumstances of postharvest activities. This means that when calculating losses, all factors need to be taken into consideration and calculations need to be carried out in different seasons. In the case of Africa, it is even harder to quantify PHL because data are missing on most of the postharvest activities or are not sufficient to be compared and transformed into percentages at national level. The economic value of these losses should also be considered when trying to quantify PHL.

APHLIS has recently put together an estimation of postharvest losses between 2003 and 2012 for grains, and what is evident is that in almost 10 years, no improvement has taken place in average production, while for some crops, namely wheat and maize, PHL have increased. This demonstrates that not enough has been done since PHL have been recognised as a real problem for food insecurity in the developing world.

Furthermore, the economic value of these losses should be considered when trying to quantify PHL, which is what the World Bank tried to do in its report.

PANGEA strongly believes that PHL is one of the main drivers of the food crisis in Africa, however this topic is often avoided in reports blaming biofuels as the main cause of food price crises.

55 eRAILS 2013

Finding solutions

The agricultural, and therefore food security, situation in Sub-Saharan Africa looks bleak at best and dire at worst when taken from the resilience point of view. The vast majority of populations are at risk of food insecurity at just about any given time because of exposure to poor harvests, climate change impacts, poor trade infrastructure, lack of market infrastructure including processing and storage, and of course postharvest losses. So rather than put the blame on biofuels for food insecurity, the roots of these food insecurity causes must be dealt with directly in order to improve food security and therefore improve incomes and increase resilience.

Education

Education can play a crucial part in the nexus of downgrading poverty statistics and upgrading yields. The role that education can play in upgrading Sub-Saharan Africa's underlying food security and regional availability issues is inherent.

Knowledge of sound eating and health practices cannot be underplayed and this has a feedback loop to agricultural production – if a community does not know that staple crops for food do not provide sufficient nutrients for growth, then agricultural productivity will be affected, affecting income, access to varied, more nutritious food (UNDP 2012), and back again to education as there will be imbalance of time spent looking after subsistence and health before educating household members. The same goes for enabling the local population to have a simple understanding of water sanitation, cooking and nutrition. Without the knowledge of this in effect, production yields will be crippled by low energy levels among workers and vice-versa.

Especially important in this nexus are women. As the UNDP has pointed out, this group makes up half the agricultural workforce of SSA (UNDP 2012). If women are educated they are seen as more valuable to household investment allocation and will be able to have a positive effect through more direct control over resources (UNDP 2012), thereby increasing the focus on more economically valuable activities.

Poor education is rarely the result of neglect by families, but hunger and the necessity to subsist can seriously damage prospects to obtain even a basic education. Resultant bad health and consistent poverty can persist over generations. Hunger can lead to communicable diseases, and coupled with little or no education these can quickly proliferate crippling communities (UNDP 2012). Dysentery, malaria and respiratory infections are quickly communicable and will hamper agricultural productivity greatly. A small amount of education can go a long way to tackling preventable outbreaks, which hamper agricultural activity.

But the effects of poor nourishment are felt at a very early age yet continue to persist in the population for possibly more than a whole generation (Victoria *et al.* 2008).

Undernourishment has a range of knock-on consequences including physical and mental development, and the causes of this are attributable to the first 1000 days from conception (Victoria *et al.* 2008). Physical stunting impairs strength and dents agricultural production. It is clear that education and health play a major part in a cyclical process, interacting with agricultural production and yields.

Ownership and finance

As has already been stated, one of the biggest barriers to increasing yields, productivity and reducing hunger falls on the principle of ownership. One area that this research has found to be lacking is the availability of finance. This is partly because income has remained consistently low and left little room for smallholder reinvestment in innovative technologies, seeds or infrastructure that could all have huge benefits, even on a small scale. Despite the highly successful Grameen Bank in Bangladesh, models of micro-financing have faced a steeper take-off curve in Africa. The reasons for this are not clear, and this report calls for further investigation into this. With small amounts of lending, the Grameen Bank has shown a very high success rate in creating small-businesses or boosting yields through better seed varieties, or better intercropping (Khandker 1996).

Micro-insurance works on the same principle as insurance but on a much smaller scale, perfect for smallholder farmers who need to mitigate against weather-related shocks. At present the lack of financial insurance means that when a crop fails through drought or flooding, there is no safety net. But, for example, with micro-insurance the farmer is covered and can find a way of recovering.

Overall, increased and better use of such financial tools can have a very positive effect in bringing about lower regional differences in the availability of food. If drought or flooding strikes in one area, it can recover through re-planting after claiming through insurance, which this majority stakeholder group of smallholder farmers could not have previously benefited from before policies covering small capital costs were developed. An increase in ownership and cottage-industry businesses funded by micro-finance can further bring up incomes and ownership levels, with less reliance on wages before considering the family's own crop.

Agro-ecological zoning

PANGEA proposes the implementation of agro-ecological zoning in African countries as one solution to increased food security and reduced risk of competition between food and other land uses,

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Agro-Ecological Zoning

is the collection of biophysical and socio-economic data. It also includes strategic and political aspects to better plan sustainable land use, taking into consideration available resources, environmental requirements and development objectives (Strapasson *et al.* 2012).

Agro-Climatic Region – An agro-climatic region is defined as a region with distinct characteristics of inter-related aspects among agronomic factors, type of exploration or system and the climate.[1]

Agro-Ecological Region – An agro-ecological region is defined as a region that has distinct characteristics of inter-related aspects among agronomic factors, farming systems and various characteristics of environmental factors, and not only climate.[2]

Agro-Ecological System – An agro-ecological system is defined as an ecosystem manipulated by frequent anthropogenic modification of its biotic and abiotic environment. Four main types of modifications have been recognised, such as: energy input, reduction of biotic diversity to maximize the productivity of economic products, artificial selection and oriented external control.[3]

1 Brunini. 2011
2 Ibid.
3 Ibid.

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including biofuels. This is an exercise that Brazil and Mozambique embraced in order to define where it is sustainable to grow crops for biofuels (namely sugarcane and oil palm, in the case of Brazil) and where, on the contrary, land should be allocated for different crops. This approach could be adapted to African countries that are planning to develop a biofuels sector and want to make sure there will be no competition for land with food production.

According to FAO (1996), an agro-ecological zone (AEZ) is a "land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use". Therefore the zoning is the action of dividing a certain area into smaller pieces which have between them similar land, environmental and production features.

This is not a new concept; FAO has been working on developing AEZ during the last 30 years[56], together with other research institutions, in order to promote better management of land. In fact, when information about climate, soil and land is available for a specific area, it is easier to plan which crops can be sustainably grown where. And when this exercise is done for a whole country, then it is possible to plan the right amount of land that can be dedicated to certain crops, avoiding any competition for land between crops and therefore diminishing the risk of increasing food prices due to biofuels. For biofuels crops this is even more evident. If it is possible to scientifically justify how much land will be attributed to fuel crops following a sustainable land management plan, then it can be affirmed that all the negative effects attributed to biofuels, such as Indirect Land Use Change and competition with food crops with subsequent food prices increase, can be avoided or mitigated.

The exercise of mapping a certain area for better land management purposes can be done in two phases, the ecological-economic zoning (EEZ) and the agro-ecological zoning (AEZ) (Strapasson, *et al*. 2012). The first is more of an instrument used by governments to better plan their policies, as it has as its main purpose the sustainable development of a given area. The AEZ is a more technical exercise and it analyses two main variations: soil and climate. Additional data on land use, logistic, topography and land tenure can be added to the analysis (Strapasson, *et al*. 2012).

Specifically, agro-ecological zoning has been adopted by Brazil to map out the land to dedicate to sugarcane production for ethanol[57] and to oil palm for biodiesel[58].

According to a recent study (Kretschmer, *et al*. 2013), there are several new mapping initiatives that have been focusing on land management, some of them with a specific focus on biofuels production[59].

Each of these initiatives has a specific focus. The BioCarbon Tracker, for example, is designed to give useful information to businesses, governments and civil society organisations interested in helping prevent carbon emissions that come from changes in land use[60]. The Responsible Cultivation Areas (RCA)[61], developed by Ecofys, has a specific focus on low indirect impacts biofuels while SuLu[62] is using the sustainability criteria of the RED to define areas for the conservation of biodiversity where biomass for energy should not be grown.

Brazil has used zoning practices for many years, both for agriculture and for environmental purposes. Specific AEZ exercises for palm oil[63]

56 GAEZ 2012

57 Embrapa 2009
58 Embrapa 2010
59 Table created by PANGEA using information from Kretschmer, B., Allen, B. and Tucker, G. 2013
60 Biocarbon Tracker 2013
61 ECOFYS 2010
62 Global Landuse Change 2013
63 Embrapa 2011

Name	Purpose	Approach
Local Ecological Footprinting Tool (LEFT)	Not specifically for biofuels	Geographic data are used to create maps. These data are used to write conclusions about biodiversity and carbon stocks
BioCarbon Tracker	With focus on biofuels	
Eyes on the Forest	Not specifically for biofuels	
International Biodiversity Assessment Tool (IBAT)	Not specifically for biofuels	
ZAE Cana	With focus on biofuels	Geographical data and social criteria
Potico	Not specifically for biofuels	
Responsible Cultivation Areas (RCA)	With focus on biofuels	Objective criteria used but without final maps
High Conservation Value (HCV) approach	Not specifically for biofuels	
SuLu	With focus on biofuels	Hybrid approach between the first two categories
Roundtable for Responsible Soy (RTRS)	With focus on biofuels	

and sugarcane[64] were recently completed with the objective of better planning biofuels production and avoiding that their expansion would happen just randomly in order to ensure production was environmentally, economically and socially sustainable.

The zonings were created for public sector to implement legislation, which makes sure biofuels crops expansion would happen in a sustainable way. Investors could also use this tool to identify where their investments will be more profitable, while respecting the environment.

Sugarcane zoning in Brazil was developed through a digital process, which took into consideration the available land for the crop without need for irrigation. Chemical, physical and mining characteristics of the soil were also considered together with climate risk, sustainable agriculture production potential and local environmental legislation. Some areas were excluded *a priori*, such as but not exclusively, Indigenous reserves, environmental protected areas and the Amazonian and Pantanal biomes. The results show that the country has 64.7 million hectares[65] of available land for sugarcane production that can be used without competing with other food crops.

For oil palm the process was similar but the main difference between the two crops is that while sugarcane does not grow in the Amazon region, oil palm does, so the study focused on already-cleared soil of Amazonia in order to best use these areas and avoid further pressure on the region. The zoning was developed considering two different land management scenarios, one where high level of capital and technology should be applied and the other where little input would be needed[66]. The study identified 70.4 million hectares available for

>>> continued on page 52

64 Embrapa 2009

65 Embrapa 2009

66 Embrapa 2011

>>> from page 51

oil palm, representing almost 14% of the so-called "Amazonia Legal" territory.[67]

Considering that:

- Africa is home to up to 60% of the world's under-utilised land[68] with about 45% of available land deemed suitable for agriculture (International Fund for Agricultural Development, 2011);
- The IEA's world energy outlook estimated that just 32% of Sub-Saharan African's have access to electricity[69];
- and that most African countries have weak land tenure systems[70]

The AEZ represents a good option for African countries to sustainably produce biofuels – which can contribute to increased energy access while not competing with food production – and to better plan land management, therefore avoiding criticism about increases of food prices driven by biofuels production. The zoning can be done either by identifying the best performing crops to be grown in a specific area or identifying the best and worst areas to grow a specific crop.

In Africa, detailed zoning for biofuels crops are still new in the region apart from Mozambique, however there are some good examples that could be followed by neighbouring countries. In PANGEA's report examining biofuels policies in Sub-Saharan Africa[71], most of the biofuels policies, guidelines and programs across the region were analysed and where a zoning would help better plan land use for biofuels crops were suggested.

One of the few African countries that has started using the AEZ to plan its biofuels crops expansion is Senegal[72]. In 2010, under the framework of the Memorandum of Understanding between Brazil and the US[73], the Brazilian consulting company FGV Projetos undertook a feasibility study on biofuels production in Senegal. The study[74] analysed the country's energy matrix and the potential feedstocks for biofuels, including the development of a zoning map for crops. A socioeconomic analysis was included in the study to prepare some recommendations to be used by the central and local governments when writing policies. The study also included recommendations for local and central government.

Following the FGV study on crop zoning, the suggested feedstocks for biofuels production in Senegal are sugarcane, sunflower, eucalyptus, and cotton. Contrary to what the government decided in 2007[75], FGV believes *Jatropha Curcas* is not yet a feasible option since the technology and feedstock are not mature, but it recognises potential future production.

This clearly supports the idea that agro-ecological zoning is a fundamental tool for legislation in Africa if they want to avoid using the wrong crops on unsuitable land. A biofuels programme or policy should not be implemented before having a first analysis of which crops are best suited for ethanol or biodiesel in a certain country.

The *SADC Biofuels State of Play Study* from 2010[76], a comprehensive study with the purpose of providing information on biofuels production and use in the region, includes information about

67 The largest socio-geographic division of the South American nation of Brazil, which contains all of the Brazilian territory in the Amazon Basin
68 Department of Trade and Industry of the Republic of South Africa. 2011
69 World Energy Outlook. 2012
70 PANGEA 2011b
71 Ibid.
72 Ibid.
73 Memorandum of Understanding between the Government of the United States of America and the Government of the Federative Republic of Brazil for the Implementation of Technical Cooperation Activities in Third Countries, 2010
74 FGV Projetos 2010
75 Ministere du Developpement Rurale et de l'Agriculture. 2007
76 SADC, GTZ. 2010

countries such as Angola, Botswana, South Africa, Mozambique, Tanzania, Zambia and Zimbabwe. They have been included in a capacity building programme promoted by Brazil to share the relevant mapping tools with these countries in order to promote increased agricultural productivity and better management of energy and food crops.

The best case study is Mozambique, which has undergone a detailed process of AEZ in recent years. The country is very engaged in promoting sustainable biofuels production on its territory, and in this regard, in 2009[77] the government published a National Biofuels Policy and Strategy built on a previous feasibility study. The strategy[78] underlined several issues, which would help the new biofuels sector to be sustainable. One of those suggestions was an agro-ecological zoning exercise. The zoning was coordinated by the Ministry of Agriculture, focusing on the agro-climatic analysis, and by the National Directorate for Land and Forestry working on the land availability analysis (Schut *et al*. 2010).

Main challenges during the zoning undoubtedly include the too-large scale (1:1,000,000) and that data regarding rainfall and soil were quite outdated. A second exercise was carried out in an attempt to fix these problems. The new scale of 1:250,000 and with focus on provinces that are more in the investors' focus, such as Manica, Sofala and Zambezia[79] made the exercise much more useful.

This second phase started with field research trying to identify potentially available zones not included in the first exercise and to better understand which is the land identified as available during the first zoning exercise but that in reality is occupied. Information was collected locally and as such this second part of the zoning process was useful to define the real situation more in detail. Much land was excluded from those identified as available for biofuels because in reality they were highly populated compared to the first zoning results. Pieces of land which were part of old public companies no longer existing have been re-defined as national reserves and have been allocated for potential biofuels projects.

> The AEZ represents a good option for African countries to sustainably produce biofuels and to better plan land management, therefore avoiding criticism about increase of food prices driven by biofuels production.

The two zoning exercises present, however, a high level of similarity (80%). In the end, 6,966,030 ha have been identified as available for potential biofuels projects. Now Mozambique has some good projects on the ground, including PANGEA member CleanStar Mozambique. They are producing ethanol and food in an integrated system, representing a good case study of how this integration is possible, sustainable and implementable.

What can be learnt from the Mozambique example

>>> continued on page 54

77 PANGEA 2011b.
78 Mozambique. 2009
79 Mozambique. 2008

>>> from page 53

is that zoning in African countries can be complicated because data are missing or are not updated. Often land information that the Ministry has in the capital is different from the reality, because people might just have occupied land for agricultural purposes. Therefore on-the-ground analysis is often needed.

Yet the benefits of a comprehensive and detailed agro-ecological zoning for African countries that are planning to invest in biofuels are manifold. First of all, the zoning will help keep under control all issues related to water security, land use, soil fertility, and social issues. The AEZ should also be used by public and private sector in order to include small farmers in the process of implementing projects on available land close to out-growers who could be included to supply the industrial process. A comprehensive AEZ should also expand its purely technical analysis and involve local communities and NGOs because, as the Mozambique example showed, there might be differences between what the models show and reality.

Proceeding with an AEZ will help to have a good understanding of crop suitability and therefore implement a better cropping system. The environment can be preserved and communities better involved in such projects when integrated into the zoning exercise. International cooperation can help overcome the technology gap and promote know-how transfer.

Tackling PHL

The PHL problem is complex because it is caused by several reasons including lack of infrastructure for storage and transport, lack of access to market, and because it is hard to quantify exactly the losses in Sub-Saharan Africa, it can be affirmed there is not a unique solution to diminish PHL. It is a real challenge to implement a collection of successful programs, which together can solve the problem.

PANGEA believes regional coordination is needed as well as a transfer of know-how. Lack of transport infrastructure is not only a problem for the agriculture sector but for other economic activities too. There are guides[80] for different crops that can be applied during the harvest and postharvest period to avoid some of these losses.

The whole supply chain should be more efficient in order to achieve PHL reductions, generating more income, and therefore contributing to better access to food and nutrition.

According to the World Bank *et. al* (2011), there are four categories of action that can be undertaken to avoid PHL:

- Better management along the PHL chain
- Pest and storage management
- Institutional arrangement for better marketing
- Support for technological improvements and adoption of better practices

So a mix of good postharvest technologies and management linked to better policies, incentives and business practices can partly solve the problem of PHL, which is a major factor in the causes of nutrition-related problems in Sub-Saharan Africa.

With an integrated system the value chain can be better managed avoiding some of the PHL. Where this is not possible, residues which often include some quantity losses, or the part of the harvest that cannot be commercialised because of quality losses, can be used for an integrated production of bioenergy. This happens in Brazil with sugarcane, but the same system could be applied in other countries and with other crops.

In terms of better managing the entire harvest and postharvest chain, PANGEA believes that integrated food and energy systems can be one

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of the management solutions to partly solve the losses problem.

Both energy and food play an essential role in modern life, as energy from good, nutritious food is crucial for sustainable development, economic growth and poverty reduction. In order to achieve food security and to make sure that people have regular access to enough high-quality food to lead active and healthy lives, diversified and integrated farming systems all play an important role.

While farming systems are primarily associated with food production, energy is key to ensuring food security. FAO has identified a model that includes both food and energy production, the Integrated Food-Energy System (IFES). IFES combine the sustainable production of food and biomass for energy generation through multiple-cropping systems, or systems mixing annual and perennial crop species (FAO 2010b).

A key opportunity to use agricultural residues and wastes is the integration of bioenergy to operate equipment such as harvesters and irrigation and power food processing, packaging and storage, all of which will lead to reduced PHL and increase food security on a local and regional basis. Food that remains nutritious for longer also allows for more trade opportunities with the knock-on effect of increased income for farmers as well as the development of an industrialised food trade that provides higher skilled jobs and economic development. This is why agencies such as NEPAD under the African Union are collaborating with partners locally and internationally, including PANGEA, to implement on-the-ground solutions integrating bioenergy from crop waste to technologies for reducing PHL.

Integrated Food and Energy Systems:

CleanStar Mozambique

CleanStar's complete "NDZiLO" cooking solution offers Mozambican households an affordable new form of cooking that is cleaner, faster and safer than using charcoal.

Based in Dondo in Mozambique's Sofala Province, the facility produces 2 million litres per year of ethanol-based cooking fuel from surplus cassava supplied to the company by local farmers following CleanStar's sustainable farming systems. The biofuel manufacturing plant is a key part of the integrated food and energy business of CleanStar Mozambique, a company formed in 2010 by Novozymes and CleanStar Ventures to use Mozambique's rising urban demand for food and cooking fuel to drive sustainable rural development and environmental restoration.

CleanStar has been transitioning local subsistence farmers from slash-and-burn farming to more resilient conservation agriculture techniques involving synergistic cultivation of crops and trees to drastically increase their production and nutrition levels. CleanStar provides participating farmers with basic inputs and technical assistance, and purchases their surpluses at its rural agricultural centres in communities around the facility. Surplus cassava is converted to ethanol, and beans, sorghum, pulses and soya are processed into packaged food products for sale in Mozambique's cities.

Conclusion

As discussed throughout the study, the Sub-Saharan African agricultural sector is currently far from realising its full potential. The adoption of more effective cultivation techniques and high-yielding seeds, together with a more widespread use of fertilizers could boost production on land that is already cultivated. Better cultivation techniques would make it possible to expand production also onto the vast amounts of marginal, low-potential land of the region, providing new markets and investment opportunities benefitting mainly poor farmers etc.

At the heart of those improved agricultural yields is education, for both women and men, that ensures access to and understanding of techniques that can help them grow more and better food to supply their families and their communities.

> Biofuels do not have to be blamed for price increases in Sub-Saharan Africa: on the contrary, the sustainable development of a bioethanol and biodiesel sector could help to assist in the frequent swings in production caused by farmers' response to market prices by keeping demand for crops stable.

But food security is not just about growing food, but about securing its supply and its access. The development of proper storage facilities would allow farmers to build up stocks and better face periods of scarcity thus ensuring a stable income throughout the year. Access to storage would help reduce PHL significantly, while introduction of bioenergy and other renewables into processing would provide increased income paired with increased market resilience.

Improving roads and market infrastructure would also incentivise the shift from subsistence to commercially-oriented agriculture and therefore stimulate increases in production along with their knock-on effects of improved incomes that lead to better education and access to more health care services, all of which are then reinvested into better agricultural yields thanks to healthy farmers with access to modern agricultural know-how.

On a larger scale, if implemented in sustainability criteria related to agriculture in general and to biofuels specifically, this shift to commercial agriculture would not involve the displacement of poor farmers from their land and would therefore greatly contribute to food security. At the policy level, local governments should seriously strengthen their agricultural sectors by improving and enforcing their land tenure systems, and subsidising crucial inputs such as fertilisers. Wider access to financial services, e.g. productive loans and insurance, would also encourage investments in agriculture.

Significant increases in production levels would help to ensure food security in Sub-Saharan Africa and at the same time would allow the sustainable development of a biofuels industry. When harvests are good, farmers respond to low prices by planting less in the next season, thus shrinking supply and causing price rises the following season. The section on food price analysis reports the examples of Uganda and South Africa's lower maize planting in 2011 following an exceptional harvest that reduced prices in 2010. If South Africa, for example, had better managed those four million tonnes of surplus maize and locally processed it into bioethanol for cooking and electricity, demand from the biofuel sector would have counteracted the falling price trend and therefore stabilised planted area and production capacity the following year.

Biofuels do not have to be blamed for price increases in Sub-Saharan Africa: on the contrary, the sustainable development of a bioethanol and biodiesel sector could help to assist in the frequent swings in production caused by farmers' response to market prices by keeping demand for crops stable. In addition, local production of biofuels would also allow countries in Sub-Saharan Africa to reduce their dependency on fossil fuel imports and their heavy exposure to international oil price fluctuation while decreasing the consequent high costs of agricultural activities. In the end, biofuels offer the opportunity for Sub-Saharan Africa to strengthen its agricultural sectors.

Large-scale production of biofuels in Africa, for Africa and for exports, do have a role to play when done well so they achieve sustainable results for the local economy as well as participate in international biofuels trade. Small-scale need not be the only viable opportunity for bioenergy in Africa, but commercial-scale projects must be developed in such a way that lifts up and provides local economic development while not exploiting the local environment.

The biofuels debate in Europe and beyond must be focused on the true challenges to sustainable bioenergy production, use and trade. Pointing the finger incorrectly, as demonstrated by the price analysis in this report, at allegedly negative impacts on African food security due to biofuels mandates outside the region only serves to inhibit the opportunities for development of a true bioeconomy in Africa and around the world. African food prices are impacted negatively by issues such as systemic lack of investment in agriculture and infrastructure, postharvest losses and climate change, but links between biofuels mandates and rising African food prices are weak at best. The focus should instead be on strengthening agricultural production in Africa so developing economies can at last achieve lasting economic development and end poverty.

Annex 1 – Local food price dynamics

Table A-1. Maize prices (June 2010-April 2011)

Country	% change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
Argentina, Up River f.o.b.	86.91%	95.73%		
US No.2, Yellow, US Gulf	104.55%			
Democratic Republic of the Congo (retail)	18.09%	38.62%	20.99%	22.25%
Ghana (retail)	n/a		35.14%	
Kenya (wholesale)	43.04%		n/a	
Malawi (retail)	-3.28%		-4.12%	
Mozambique (retail)	22.92%		8.15%	
Mozambique (wholesale)	12.70%		0.69%	
Namibia (retail)	118.18%		100%	
Niger (retail)	10.46%		-7.15%	
Nigeria (wholesale)	2.86%		7.69%	
Rwanda (wholesale)	52.17%		n/a	
South Africa (wholesale)	71.43%		51.85%	
Tanzania (wholesale)	7.56%		n/a	
Uganda (wholesale)	104.17%		n/a	
Zambia (retail)	17.39%		9.22%	
Zimbabwe (retail)	34.78%		n/a	

Source: FAOSTAT

Table A-2. Rice prices (June 2010-November 2011)

Country	% Change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
Thailand, A1 Super, f.o.b. Bangkok	68.98%	52.96%		
Thailand, 100% B second grade, f.o.b. Bangkok	36.94%			
Burkina Faso (imported, wholesale)	13.05%	22.40%	1.80%	17.73%
Democratic Republic of the Congo (retail)	21.81%		13.58%	
Madagascar (imported, retail)	28.57%*		22.11%	
Madagascar (local, retail)	41.86%*		37.00%	
Malawi (retail)	25.83%		49.05%	
Mali (imported, wholesale)	30.17%		19.50%	
Mali (local, wholesale)	25.34%		17.65%	
Mozambique (retail)	13.28%		2.19%	
Niger (retail)	26.13%		13.60%	
Niger (wholesale)	29.69%		17.08%	
Rwanda (wholesale)	2.81%		n/a	
Senegal (retail)	13.14%		1.42%	
Tanzania (wholesale)	3.80%		n/a	
Uganda (wholesale)	50.67%		n/a	
Zambia (retail)	9.87%		1.85%**	

*July 2010 – Nov 2011 **June 2010 – May 2011 Source: FAOSTAT

Table A-3. Sorghum prices (June 2010-August 2011)

Country	% Change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
US No.2, Yellow, US Gulf	94.36%	94.36%		
Burkina Faso (wholesale)	22.89%	7.94%	3.69%	3.87%
Ethiopia (retail)	20.24%		48.58%	
Mali (wholesale)	27.96%		8.50%	
Niger (retail)	-6.88%		-12.82%	
Niger (wholesale)	-6.47%		-17.16%	
Nigeria (wholesale)	12.90%		14.89%	
Senegal (retail)	28.21%		9.76%	
Sudan (wholesale)	-35.29%		-24.44%	

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Table A-4. Wheat prices (June 2010-May 2011)

Country	% Change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
Argentina Up River f.o.b.	68.35%	78.31%		
US No.2, Hard Red Winter, US Gulf	97.95%			
US No.2, Soft Red Winter, US Gulf	68.62%			
Democratic Republic of the Congo (flour, retail)	10.08%	24.36%	12.62%	38.97%
Ethiopia (white, retail)	23.79%		53.38%	
South Africa (wholesale)	56.67%		41.05%	
Sudan (wholesale)	6.91%		22.48%	

Source: FAOSTAT

Table A-5. Cassava prices (July 2010-September 2011)

Country	% Change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
Democratic Republic of the Congo (retail)	26.00%	52.41%	28.77%	34.04%
Malawi (retail)	33.33%		34.79%	
Mozambique (retail)	56.25%		21.77%	
Mozambique (wholesale)	77.78%		50.84%	
Uganda (retail)	43.33%		n/a	
Uganda (wholesale)	77.78%		n/a	

Source: FAOSTAT

Table A-6. Millet prices (September 2010-September 2011)

Country	% Change (USD)	Average change (USD)	% change (local currencies)	Average change (local currencies)
Burkina Faso (wholesale)	30.14%	38.38%	18.66%	35.22%
Ethiopia (retail)	40.32%		82.05%	
Mali (wholesale)	26.38%		14.72%	
Namibia (retail)	60.00%		55.60%	
Niger (wholesale)	31.80%		24.58%	
Senegal (retail)	39.94%		37.98%	
Sudan (wholesale)	40.06%		33.79%	

Source: FAOSTAT

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