Newton Nyairo & Stefan Bäckman

Analysis factors affecting supply of agricultural products: market liberalization, agricultural policies, bioenergy policies, population growth, input price development, trade policies and other relevant factors
Sustainable Rural Development with Emphasis on Agriculture and Food Security within the Climate Change Setting (SARD-Climate) Deliverables

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The SARD-Climate project provides report containing an analysis and policy recommendations for a development policy aiming at a Sustainable Development with regard to agriculture and rural areas, food security and climate. The project has been coordinated by Professor John Sumelius at the Department of Economics and Management, Faculty of Agriculture and Forestry, University of Helsinki. Dr Stefan Bäckman has been a project secretary. The project was carried out in cooperation with MTT Agrifood Research Finland Dr, Reimund Rötter and Dr Helena Kahiluoto.

The following reports have been issued:

1. General theoretical framework (John Sumelius, Stefan Bäckman, Reimund Rötter, Helena Kahiluoto)
2. Start-up document (John Sumelius, Stefan Bäckman)
3. Investigation of the effects of increases in agricultural productivity with regard to food security, employment and rural development in general (Newton Nyairo, Tuulikki Parviainen, K.M. Zahidul Islam and Stefan Bäckman)
5. Effects of land tenure and property rights on agricultural productivity in Ethiopia, Namibia and Bangladesh (Shimelles Tenaw, K.M. Zahidul Islam and Tuulikki Parviainen)
6. Effects of developing country policies on agricultural services, extension, rural infrastructure and energy, health care, water and sanitation (Md. Motaher Hossain and Shimelles Tenaw)
7. Identifying the driving forces behind price fluctuations and potential food crisis (Stefan Bäckman and John Sumelius)
8. Analysis factors affecting supply of agricultural products: market liberalization, agricultural policies, bioenergy policies, population growth, input price development, trade policies and other relevant factors (Newton Nyairo and Stefan Bäckman)
9. Rural financial services and effects of microfinance on agricultural productivity and on poverty (Shimelles Tenaw and K.M. Zahidul Islam)
10. Fair Trade coffee certification. A tool for rural development and environmental protection in Nicaragua? (Joni Valkila)
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Sustainable Rural Development with Emphasis on Agriculture and Food Security within A Climate Change Setting

Task 8: Factors Affecting Supply of Agricultural Products

Newton M Nyairo
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Abstract
This portion of the research project will provide an evaluation of the factors affecting agricultural supply in Kenya and Zambia. These two countries are long term development partners with Finland. This research task is a segment of the larger research project which assesses sustainable agriculture and food security within a climate change setting. Wide ranging factors impinge on agricultural supply. In recent years, literature on the link between climate change and agricultural production has become common (FAO, 2008; Kabubo-Mariara, 2007). The presumed contribution of such factors to agricultural production have tended to vary from region to region. In some other cases, the scope of national policies, human activity or population pressure have contributed to the development of agriculture. The general outlook of this task highlights the factors affecting the supply of agricultural products. The focus of this analysis considers how sustainable agriculture and food security have evolved in Finland's long-term development partners (Kenya and Zambia). However, the countries considered in this research are Kenya and Zambia. Finland continues to support a policy of nurturing sustainable development projects. Sustainable development policies will require a comprehensive evaluation of the conditioning environment and factors that would ensure a sustainable and lasting impact on the beneficiary countries. With regards to those factors affecting agricultural supply, this report will provide recommendations that will improve the management and targeting of priority areas. Many people in both Kenya and Zambia reside in rural areas where agriculture is a major source of food and income for them. National governments in conjunction with external agencies are working towards determining ways in which food production and incomes can be sustained. An important worldwide initiative was launched by the United Nations through the Millennium Development Goals (MDG). The increasing majority of people in developing countries rely on agriculture for food and income.

2. Agricultural organization in Kenya and Zambia
There are general and obvious factors contributing to the state of agricultural production and ensuring a sustainable capacity. These elements differ from country to country in practice. However, there may be similar overall trends on the factors. For the case of Kenya and Zambia, the agricultural sector shares similar characteristics. However, for Zambia, in the agricultural sector there is a slight divergence of the factors that affect supply. These factors are in turn influenced by the extent of agriculture's contribution to the national economy; agricultural and non-agricultural interlinkages. For a major portion of the country's history, the mining industry has dominated the national economy, making agriculture less important in terms of investment value.

The core objective of this study is to provide a valuable analysis of agricultural supply trends in both countries and to use such information in the formulation of continued future partnership and to enhance participation in mutually beneficial development cooperation between Finland and its program countries. Currently, various sector development partnerships exist between Finland and its program countries. Further initiatives towards greater capacity building and support aimed at meeting the development needs of the recipient countries are always a subject of discussion within development cooperation. Greater optimal gain from future aid projects, for instance, depends on how current and future approaches can be made more efficient. Current development aid projects exist in the areas of developing agriculture, the environment and the optimal use of natural resources. In some of these environmental support areas, the issue of climate change has not been given sufficient attention given its direct impact on agriculture.
2.1 Agriculture, food security and climate change

Sustainable agriculture refers to a food system that provides a reasonable rate of return to farmers, to sustain farm families, agricultural infrastructure, and rural communities. Such system also assures a reasonable rate of return to public and private providers of farm inputs, information, services and technologies. Sustainability also entails the preservation and generation of soil, water and biological resources upon which farming depends.

Food security under this study is used to refer to access to all people at all times to enough food for an active and a healthy life (FAO, 2003). Households are considered to be food secure when several conditions have been met. First, enough food must be available on both quantity for adequate energy intake and the diversity of food types for adequate nutrients. Second, food security must consist of access to these foods by means of endowments and their transformation into food entitlements. Finally, food security must be sustainable through seasons and over years by guaranteeing its continual availability.

There are ongoing debates on the long-term effects of green house warming on agricultural production. That debate has moved further from whether the effects of greenhouse warming are potentially harmful to the environment - particularly the probable effects on climate change patterns (Monastersky, 2009). The link between agriculture and the effects of climate change are obvious in some cases. If then the claims about the effects of green house gas emissions are true as projected, the need for measures to mitigate such effects on the agricultural sector in the near future need to be upgraded. Current research concludes that climate directly affects agriculture through changing rainfall patterns. That in turn alters productivity for farming activities that rely on rain-fed agriculture. Consumption and producer incomes that depend on agriculture to sustain livelihoods are rendered vulnerable due to limited adaptive capacity. The total effect of economic and social interactions brought to bear by climate change requires careful management so as to mitigate any adverse effects.

Many households in developing countries base most of their food supply from domestic agricultural production. Agriculture also contributes between 30 and 60 per cent to the gross domestic product of Finland's program countries on average. The distribution of the labour force by occupation are not clear cut, but the agricultural sector, directly or indirectly, employs a major portion of the rural labour force. It is common to find that the labour consist of mainly untrained labour used in agricultural production requiring unsophisticated production techniques. Agricultural productivity, measured in terms of production per hectare, is constrained by their small farm size. Disregard of the adverse effects of the overexploitation of the soils by repeated application of fertilizers, some are harmful to soil ingredients.

Existing research conclude that climate change will have significant impacts on agriculture in the East African region (Thornton et al., 2008). This conclusion is based on modeling studies that have been built to show areas where those impacts will be largest and to help guide adaptations to ensure food security in the next several decades. Some of the results suggest drastic reductions in crop yields, between 50 to 70 per cent, of the areas that have been simulated. Highland parts of the East African region may see an increase in yields, which would have a potential of offsetting any income and food security threats.

Many of the projected impacts climate change are expected to pose serious problems for development in Sub-Saharan Africa. Many of these impacts will be felt in agriculture and they will play a direct and indirect role in poverty and will provide an indispensable platform for wider economic growth that will in turn reduce poverty beyond its concentration in the rural areas (Thornton et. al., 2008). In the attainment
of economy-wide progress, development agencies can participate in planning and implementation of appropriate adaptation strategies. However, knowledge gaps still exist regarding the stresses of existing impact of climate change on poverty and food security. Clear understanding on how household may be affected by increased climate variability and climate change has to be established in order to target adaptation strategies to the regional needs.

3.1 Kenya: Agricultural sector

Kenya is a small country of close to 39 million citizens according to the latest estimates. Agricultural production remains an important sector in the economy of Kenya. Overall, agriculture contributes at least 23.9 percent of gross domestic product (GDP) and over 75 percent of total direct employment (UNDP, 2005). Agriculture is divided between large scale and small-scale production and there exist a wide range of crops that are produced. In the last few years, large-scale producers have declined significantly due to changes in land use.

Agricultural land area in Kenya is classified broadly into three categories: high potential and low potential based mainly on the amount of rainfall received. The high potential areas receive an annual average rainfall of 857mm or mover and covers about 13 per cent of the total land area. The medium potential areas receive an annual average rainfall of 735mm to 857mm and cover about 7 per cent of the total land area. The low potential areas receive an annual average rainfall of 612mm or less and cover roughly 80 per cent of total land area. Within these different land classifications, agriculture takes place in the most potential areas and it is the main activity that serves as a source of employment and foreign income for the country.

Agricultural trade is a flashpoint for tension in the Doha Round. The rules governing world trade are bitterly contested. Kenya is a founding member of the world trade organization (WTO). Close to 70 per cent of Kenyan farmers reside in rural areas where smallholder agriculture is their main livelihood activity. According to conducted research, more that two-thirds of all people surviving on less than $1 a day live and work in rural areas (UNDP, 2005). Kenya's rural populations whose incomes and food are rooted in the agricultural sector are mainly poor and themselves victims of unfair trade practices. These practices hamper rural agricultural progress. Access to inputs and services important in increasing their agricultural supply become difficult due to their meager incomes. It is documented that every year $350 billion is the amount of direct and indirect subsidies that are pumped into the agricultural sector (UNDP, 2005). It has been argued that this has far reaching effects on rural farmers in agricultural countries such as Kenya with developed country farmers in international markets. Subsidized exports undercut them in global and in local markets, driving down proceeds received by farmers and the wages received by agricultural laborers.

Rapid export growth, mostly triggered by increased agricultural production, is assumed to be an important pathway to poverty reduction. The rise of production and export of high value-added products, fruits and vegetables, from both Kenya and Zambia have generated rising incomes. However, only a small group of producers benefit from the rising prices and corresponding revenues. High value production remains concentrated in large, capital-intensive farms and managed by commercial producers with weak links to the rest of the economy (UNDP, 2005). The effect of increased revenue from these exports is only concentrated among a few intensive producers and entry is restrictive within those who have sufficient capital capable of meeting the market demand. While this sector is considered the fastest growing and an engine, for poverty alleviation and rural development, small-holder farmers are unable to compete. The contribution of these high-valued product exports are not a viable route to higher rural incomes.
The protracted crisis in coffee markets, which demonstrates the devastating consequences of a wider crisis in commodity markets, represents the failure to raise the share of market prices received by growers (Krivonos, 2004). Kenya is one such country which has implemented reforms and where the government continues to indirectly regulate the coffee industry. There is a growing trend in designer coffee shops in developed countries, where the prices of coffee and the profits of retail outlets are soaring; the coffee crisis is scarcely visible. The high prices are not reflected on the producer level and the low prices on coffee affects negatively the livelihoods of millions of poor rural farmers who depend on it for its income. Coffee production is durable and the farmers can respond to short term price changes. Coffee prices in international markets have continued to be on the downward spiral. Nine countries in Sub-Saharan Africa and Central America depend on coffee for one quarter of their export earning (UNDP, 2005). Kenya is one of the main producers of coffee and has been hit hard by this fluctuating trend in coffee prices. Many farmers have now begun to switch to other products and have incurred huge adjustment costs. Growth and revenue generation in the main commodity exporters have experienced a fast decline. The trend in international commodity markets has a strong bearing in Kenya's progress toward poverty reduction and achieving the Millennium Development Goals (MDG).

In the rush to liberalize commodity markets, donors and governments have compounded the problems of commodity producers. While state enterprises (as was the case in Kenya and Zambia) were inefficient and corrupt, they provided the producers with the necessary inputs and credit for use in production. Loss of these services has implied that entry into global markets, particularly for high-valued markets, is difficult.

3.2 Zambia: Agricultural background

The agricultural sector's contribution to gross domestic product in Zambia is 18 per cent and roughly 39 per cent of earnings of non-traditional exports, though these figures keep fluctuating due to the dependence on rainfall. Agricultural production in Zambia and current policy framework are deeply rooted in a historical context. To understand the political and historical factors propelling agricultural policy in the region requires an understanding of the type of farming that the colonial government supported. The growth of maize was common and it represented a social contract that the post-independence government made with the African majority to redress the neglect of smallholder agriculture during the colonial period (Jayne et al., 2007).

Beginning from independence, the main goal of government policy was to promote smallholder welfare, using maize production incentive as the main engine (Jayne et al., 2007). This goal came to be achieved with great success in the 1970s and 1980s in the form of large quantities of output harvests in the potential agricultural regions of the country. The production growth was largely driven by input and crop marketing policies. Crop marketing policies as well as input procurement policies were managed and financed directly by the state. Heavy subsidization of fertilizer and the encouragement of its use was supported by the state. The state further moved in to expand state market infrastructure in smallholder areas with massive expenditures devoted to fertilizer subsidies fueling maize production in the 1970s and 1980s.

The introduction of maize seed varieties was another means through which agricultural productivity has been substantially improved. The government engaged in germ-plasm research during the 1970s through activities conducted by international experts in breeding and germ-plasm collection. Access to this maize breeding expertise contributed immensely to a rapid rise in productivity as well as available variety options to choose from. Through the 1990s there were several impressive arrays of ten double and three-
way crosses, and two flint-types, early-maturing, improved open pollinating varieties (Jayne et al., 2007). For maize production, these improved varieties were promoted by the state and widely accessible to farmers. The use of these varieties raised the rate of return to fertilizer use and this combination was synergistic. Overall, maize production dominated smallholder agricultural production and raised the value of its production. During the 1980s and 1990s, maize represented 76% of total smallholder agricultural production. This trend has important implication for the maize crop in the agricultural sector in Zambia.

In terms of the rising trend in agricultural productivity, the state model of service provision for smallholder agricultural producers boosted agricultural production and incomes for these producers. However, major problems in the mid-1980s emerged sending input and marketing enterprises towards reform. Escalating marketing costs and the increasing complexity of the support activities became a huge fiscal burden. On this basis, structural adjustment programs were introduced in the 1980s in order to reign in on the government’s massive expenditure on the agricultural sector. It can be deduced from the available statistics that the overall reductions in subsidies originally available to agricultural producers and consumers contributed to a shift in cropping patterns.

Table 5.1 Major crops produced in Zambia (metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Maize</th>
<th>Groundnuts</th>
<th>Sunflower</th>
<th>Cotton</th>
<th>Wheat</th>
<th>Tobacco (1)</th>
<th>Tobacco (2)</th>
<th>Paddy rice</th>
<th>Sorghum</th>
<th>Millet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989/90</td>
<td>1,119,670</td>
<td>29,450</td>
<td>29,450</td>
<td>36,536</td>
<td>53,601</td>
<td>1,550</td>
<td>3,489</td>
<td>9,293</td>
<td>19,591</td>
<td>31,531</td>
</tr>
<tr>
<td>1990/91</td>
<td>1,095,908</td>
<td>19,161</td>
<td>16,361</td>
<td>48,721</td>
<td>58,732</td>
<td>1,300</td>
<td>2,655</td>
<td>14,186</td>
<td>20,939</td>
<td>25,573</td>
</tr>
<tr>
<td>1991/92</td>
<td>483,492</td>
<td>19,833</td>
<td>10,645</td>
<td>25,899</td>
<td>54,490</td>
<td>1,050</td>
<td>1,258</td>
<td>9,325</td>
<td>13,007</td>
<td>48,029</td>
</tr>
<tr>
<td>1992/93</td>
<td>633,326</td>
<td>20,504</td>
<td>1,493</td>
<td>47,851</td>
<td>69,286</td>
<td>2,514</td>
<td>4,138</td>
<td>15,742</td>
<td>35,448</td>
<td>37,394</td>
</tr>
<tr>
<td>1993/94</td>
<td>679,356</td>
<td>34,301</td>
<td>15,479</td>
<td>33,093</td>
<td>60,944</td>
<td>1,083</td>
<td>5,015</td>
<td>13,993</td>
<td>35,068</td>
<td>62,644</td>
</tr>
<tr>
<td>1994/95</td>
<td>520,165</td>
<td>34,732</td>
<td>9,821</td>
<td>16,578</td>
<td>38,019</td>
<td>1,560</td>
<td>2,240</td>
<td>6,358</td>
<td>26,523</td>
<td>54,501</td>
</tr>
<tr>
<td>1995/96</td>
<td>675,565</td>
<td>36,119</td>
<td>13,649</td>
<td>40,824</td>
<td>36,019</td>
<td>1,892</td>
<td>1,950</td>
<td>12,110</td>
<td>35,640</td>
<td>54,858</td>
</tr>
<tr>
<td>1996/97</td>
<td>649,039</td>
<td>34,755</td>
<td>26,178</td>
<td>75,412</td>
<td>57,595</td>
<td>2,360</td>
<td>4,399</td>
<td>13,296</td>
<td>30,756</td>
<td>61,129</td>
</tr>
<tr>
<td>1997/98</td>
<td>510,372</td>
<td>45,859</td>
<td>74,332</td>
<td>66,897</td>
<td>70,810</td>
<td>2,827</td>
<td>6,848</td>
<td>6,399</td>
<td>25,399</td>
<td>62,236</td>
</tr>
<tr>
<td>1998/99</td>
<td>818,149</td>
<td>56,934</td>
<td>5,708</td>
<td>58,381</td>
<td>89,743</td>
<td>3,762</td>
<td>4,838</td>
<td>14,700</td>
<td>13,914</td>
<td>60,413</td>
</tr>
<tr>
<td>1999/00</td>
<td>1,052,806</td>
<td>57,246</td>
<td>7,664</td>
<td>58,276</td>
<td>90,000</td>
<td>3,350</td>
<td>6,183</td>
<td>8,835</td>
<td>26,898</td>
<td>42,863</td>
</tr>
<tr>
<td>2000/01</td>
<td>801,877</td>
<td>53,251</td>
<td>19,176</td>
<td>49,282</td>
<td>82,264</td>
<td>4,196</td>
<td>7,420</td>
<td>12,387</td>
<td>30,245</td>
<td>49,606</td>
</tr>
<tr>
<td>2001/02</td>
<td>839,783</td>
<td>76,194</td>
<td>7,588</td>
<td>65,979</td>
<td>74,527</td>
<td>4,930</td>
<td>7,941</td>
<td>5,303</td>
<td>16,801</td>
<td>37,615</td>
</tr>
<tr>
<td>2002/03</td>
<td>1,207,202</td>
<td>82,550</td>
<td>4,860</td>
<td>64,659</td>
<td>84,000</td>
<td>12,465</td>
<td>8,462</td>
<td>10,744</td>
<td>20,301</td>
<td>35,331</td>
</tr>
<tr>
<td>2003/04</td>
<td>1,213,601</td>
<td>69,696</td>
<td>13,857</td>
<td>144,307</td>
<td>82,858</td>
<td>20,000</td>
<td>16,000</td>
<td>11,699</td>
<td>24,467</td>
<td>39,784</td>
</tr>
</tbody>
</table>

(1) Burlington Tobacco  
(2) Virginia Tobacco  
Source: Central Statistical Office, Zambia.

The statistics from table 5.1 reflect an increasing trend in overall crop production in Zambia. The trend visible is on all the major crops produced in the country starting from the end of the 1980s. One of the conclusions that can be drawn from the rising trajectory may be attributed to the growing emphasis on the agricultural sector particularly after the fall of the mining industry. The closure of mining activities in the Copper Belt (copper producing province in Zambia) there was a wave of labor moving to rural areas in search of income generating activities.

Maize emerges as one of the main staple crops in Zambia and an indicator of food security in the country. Except during a few years when production remained around 500,000 tons a year, during their years production rates are rather above a million tons a year. There are clear links between changes in
agricultural policies and domestic agricultural production. For instance between 2000 and 2008 agricultural expenditure was driven by the prevailing government ideology regarding the role of the state in agricultural development. The sector's dependence on donor funding also shifted during the 2003 when government funding was increased in order to finance fertilizer subsidies and other food price subsidies (Govereh et. al., 2009). In some cases, output changes from year-to-year may also be attributed to natural and other man-made factor. The most common output interruptions have been floods as well as droughts.

There is an evident widespread growth in the agricultural sector overall. However, the decline in the level of government support has contributed to the fall in maize output and a rise in output and the area of crops less dependent on fertilizer. While this trend has certain economic implications, maize continues to remain an important staple food for many households. There have also been intense debates on with the introduction of genetically modified (GM) crops would contribute to agricultural productivity in Zambia. Contained in such debate has been the claim that the introduction of GM crops would contribute to food security in Zambia. The debate for the adoption of GM crops is posing a great challenge to the future of agricultural infrastructure in Zambia. The main danger lies in the threat that if poses to the survival of the small-scale majority (Lubozhya, 2002). The proponents of GM crops view these crops as part of the key solution to boosting and stabilizing rural incomes; while traditional crop proponents argue that it is one way of impoverishing the rural farmers. It would be too simplistic to argue that by producing larger amounts of maize would ensure sufficient access by domestic demand. The intricate issues surrounding GM crops, particularly with regard to inputs, would in the long run be a disincentive for agricultural productivity growth. The acquisition of patents under the Intellectual Property Rights (IPR) would imply that the acquisition of GM crops would make it more expensive for small-scale farmers to obtain.

Research into whether genetic modification increases productivity on existing fields has mixed results. There is a debate as to whether agricultural productivity would be improved from its current level if GM crops were introduced. Independent reviews have also made the claim that GM crops would require more herbicides that what farmers were initially made to believe, leading to increased weed management costs (Lubozhya, 2002). Such claim cannot be taken at face value, particularly given the fact that developing countries lack the sophisticated support system available in the US and in Europe.

3.2.1 Factors affecting agricultural supply

The yield increasing technological changes available for cereal production include improved seed varieties and modern inputs. In Zambia, hybrid maize varieties have been available since the 1960s and were introduced to farmers in the 1970s (Kumar, 1994). The continuing dependence on inputs for agricultural production make their rise in prices a threat to farmer's access. The rate of use of these inputs in agricultural production in Zambia and Kenya depends on their prices. To maintain a higher level of yields implies that adequate use of seeds and other inputs. The upward trend in agricultural supply in Zambia during the 1990s can be attributed to the prices of factor inputs. Kumar (1994) argues that an increase in maize supply among can be attributed to their access to hybrid maize seeds as well as other agricultural inputs.

The major inputs in agricultural production are fertilizer, pesticides and hybrid seeds. By the end of the 1990s the general prices of fertilizers had drastically risen in line with the exchange rate over a period of 10 years with consumption increasing from 20,181 tones in 1997/98 to 35,128 tones in 1999/00 (Govereh et al., 2005). Zambia incurs higher transportation costs because it is land-locked. In effect, the prices of these fertilizer imports are affected on two fronts. Being a land-locked country input prices tend to be a
function of the transportation costs incurred in the procurement and delivery of those inputs from the ports of entry to the final consumer. Transportation from the ports to the interior of the country in roads that are commonly poor takes time. At the end of the 1990s, smallholder consumption of fertilizer increased proportionately with output increase. Output increase was particularly disproportionately higher in maize production than in non-traditional crops.

Agricultural supply in Zambia and Kenya has recently been depressed by changing weather conditions (Reid, 2005). These depressing factors have reduced the potential for higher yields due to less than sufficient rains as well as late rains. These weather episodes have been associated with the global phenomenon of climate change. The arid and semi-arid parts of East Africa, particularly in northern Kenya, have been worst hit by prolonged drought spells causing livestock deaths due to shortage of water and vegetation for grazing. In the East African region the changing rainfall patterns can be associated with the declining agricultural supply. Turning to irrigation for agricultural production has not been readily exploited, but Zambia has made some progress in exploiting its underground water resources in the western region of the country (Govereh et al., 2009).

Research commissioned by the UK Department for International Development (DFID) concludes that there is a strong correlation between agricultural production and rainfall patterns in the country. This study cites the countrywide 1992 drought, the partial drought in 1995 and the El Niño phenomenon in 1998 as major natural events that greatly contributed to remarkable drops in agricultural productivity. Whether these occurrences can be attributed to climate change cannot be accurately established due to lack of sufficient supporting data. Smallholder producers, nearly 70 percent, dominate agricultural production in Zambia. There is widespread unexploited irrigation potential, so most of this production is dependent on rain-fed agriculture. The heavy rains of 2001 and the drought of 2002 are a few examples of the rainfall swings in Zambia. After the 2002 drought, which led to large shortfalls in overall agricultural output, the Government encouraged large-scale farmers to produce crops under irrigation in case of prolonged droughts. Other developing countries in the Sub-Saharan African region are exposed to similar swings in their production due to the changing rainfall patterns. Recent droughts and, in other cases, floods have been attributed to climate change without any hard evidence to back such claims. Some of those disruptions once they occur tend to disrupt and to displace agricultural activity.

Between 1990 and 2000, the population growth rate in Zambia averagely grew at a rate of 2.6 per cent. During the same period, the average agricultural growth rate was around 4.5 per cent. The annual population growth rate was slightly less than 2 per cent. Some have argued that the slowing rate is attributed to a rise in the mortality rate brought about by a high incidence of AIDS. The high incidence of AIDS is a constraint to the agricultural sector because it debilitates productive labor. A combination of these effects precipitate a rise in the rate of poverty due to declining agricultural incomes, which anchor many rural households. The potential for agricultural growth and poverty alleviation depend on farming organization, productivity growth and access to required inputs. There is a widespread spike in literature that supports the view that the prevalence of HIV/AIDS stunts the growth of agriculture by depriving agriculture of the labor necessary for its growth. However, this cannot be accepted as a national trend given that there are no empirical studies that show a similar national trend. The effect of the pandemic considered as a general view

Trade policies are important instruments that can be used for the agricultural sector. Policies well thought out can have a positive development impact on domestic agricultural supply. In Zambia during the 1990s, the government attempted to encourage the export sector by putting in place incentives such as an appropriate exchange rate regime, financing facilities, duty exemptions and low duty rates in order to
promote production for export (IDL, 2002). These incentives contributed to rising export values of non-traditional agricultural exports. Wide-ranging productivity increases have therefore been experienced during some years. A number of horticultural products by small and medium-scale farmers have all witnessed a surge in productivity. Products such as cabbage, and tomatoes are the most common vegetables that are grown. Emphasis on these products implies that the spread of the range of products has been increasing largely in response to external demand.

In theory, prices are an important incentive in determining the supply of agricultural commodities in markets. Producer rationality to raise supply to the market is mainly driven by the projected level of earnings. Conversely, low producer prices result to low market supply. The rise of horticultural supply from Kenya is driven by prices offered in the destination markets, mainly European markets (McCulloch & Ota, 2002).

4. Agriculture and global climate change

Agriculture and agricultural product supply in Kenya and Zambia are human activities that are influence by and determined by risks arising from climate change. Agriculture itself is a major driver of environmental and climate change (FAO, 2007). These influences are passed on by human activities on land and water resources. Agriculture's dependence on water for irrigation is the main source of water resources consumed from lakes, aquifers and rivers. As a result of these activities, agriculture contributes immensely to land degradations, particularly in the emission of greenhouse gas emissions (GHG).

Developing countries have attempted, in small steps, to mitigate the effects of agriculture on climate change mainly by engaging in agricultural activities that are environmentally friendly. Kenya and Zambia have set research various stations conducting research on environmental resources. In Kenya, ongoing research carried out by the Kenya Forestry Research Institute (KEFRI) contributes significantly in maintaining research and awareness on the value of forests. However, the complex mix of actions both by the forestry sector and the public require a portfolio of adaptation and mitigation strategies that require careful harmonization to be effective. Such strategies would have take into account the complex public energy needs, for the case of forestry development in these countries.

The emergency of bio-fuels as a means of mitigating the effects of climate change, alleviating global energy and foster rural development have altered supply and price dynamics of global agriculture. Increased production of bio-energy raises concerns over sustainability issues and the threat they pose to food security. The production of this energy utilizes cereals, which are in high demand for consumption and for animal feed. This therefore makes it important to consider their impacts on developing countries of the wide-scale production of bio-fuels, in terms of both sustainable development and food security. A research conducted on that subject concluded that bio-fuel production threatens food supplies to humans by diverting land, water and other resources away from food and feed crops (OFID, 2009). This makes the contribution of ‘green’ technology deceptive, with only second-generation bio-fuels only appearing to offer interesting prospects.

Higher food prices resulting from bio-fuel production would consequently leading to a reduction on food consumption in developing countries, which in turn would result in increased undernourishment. South Asia and Africa are the most affected regions in terms of the total population undernourished. The ambitious Millennium Development Goals of reducing world hunger by half by 2015 seems highly unlikely to be achieved. The concentration of the undernourished in Africa would rise in response to a rise in food prices.
5. Summary and conclusions

The changing trend in the factors affecting the agricultural sector requires dynamic investments and incentives that would warrant sustainable development. The impact of climate change cannot be ignored while assessing those impacts. While some of the climate change scenarios put forward by climate change ‘worst-case-scenario' proponents do not provide hard evidence, the general indication of it is that there are negative impacts that have the potential to adversely affect the sustainability of the agricultural sector. Collective effort is necessary in order to mitigate both short and long terms effects on livelihoods of people in its partner countries.

Agricultural policies need to be structured so as to provide support to smallscale farmers through projects to improve, diversify and market agricultural products. For the case of Kenya the existing Kenya Joint Assistance Strategy (KJAS) should be maintained, improved and expanded to cover more rural producers. Improving the delivery of services to the poor can be done through other public, private sector and civil society channels. Delivery improvements are important in enabling producers to improve their production levels and increase production for the market as well as for consumption.

With regard to Zambia, agricultural production, which is evidently dependent on rain-fed agricultural production, would be need improvement in order to strengthen irrigation capacity. The country is richly endowed in ground water, a major source that can facilitate expansion of more irrigated land, particularly during periods of sporadic rains. The Congo/Zaire and Zambezi river basins have abundant ground water resources that can service around 523,000 ha of land of which current capacity is only 9 per cent and mostly by large-scale farmers.

Agriculture and forestry significantly contribute to climate change in ways that are sometimes difficult to quantify. However, governments and the relevant sectors should support agriculture by promoting safer production techniques and educating farmers about the inputs which are not harmful to the environment. However, further emphasis and support on capacity building through increased training and monitoring farm progress would be used as a means of supporting safe agricultural practices.
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