BRAINS FOR AFRICAN LAND AND FOOD

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Abstract

From "lost continent", Sub-Saharan Africa has turned into an eye-catcher in a relatively short period of time. Although malnutrition, triggered by poor soils, drought, locust invasions and civil strife is still rampant in parts of the continent, agriculture is increasingly seen as an engine of growth. This is triggered by several processes that take place at the same time: growing global population and changing diets, competition between food and biofuels, and recurrent droughts, floods, cold spells and fires elsewhere. The price increases that accompany these processes make Africa attractive as it still has ample empty land, and there is room for intensification of production. Other parts of the world that face increasing net imports of food tend to "land grab" in Africa, so as to secure their own domestic food supply. The big question is whether current curricula in African universities and those abroad adequately cover this important development, and whether students learn to think and analyse from a global helicopter view. The second question then is whether alumni can use these insights in a job situation after obtaining their degree. It is argued that a new generation of "African agribusiness brains" is needed to lead and support development from within. This covers the entire range from sound management of scarce natural resources to agribusiness, and from safety net development for the needy and the refugee to improved producer-market relations and commercial, sustainable food chain development.

1. Introduction

As food security becomes a compelling issue between now and 2050, when more than 9 billion people will live on Earth, there is a need to develop and cherish the brains on this topic. As Africa will play a key role, it is important to take a look whether curricula on African agriculture, or 'land and food' for Africa need scrutiny. The paper does not indicate what should be taught in which part of which course, but tries to single out some major fields of knowledge that should be shared by all involved in this field.

The paper addresses the following topics:

- Agronomic context
- Chains, cycles and scales
- Policies, legal frameworks
- Realizing a food-secure population

On a general note, it is suggested that students should learn about the following issues at the BSc. Level. It sets the scene for further specialization.
• Africa is an old continent, and has mainly weathered, red soils of low fertility. The Rift Valley area and some pockets of recent volcanic and alluvial origin are better off, and have more to offer to crops.

• Africa has > 50 countries of which > 15 are ‘landlocked’. This makes the continent complex compared to South-America, which has more less half the size of Africa, but only 13 countries of which 2 landlocked.

• Population in Africa is relatively spread over the continent, and was initially very rural. South America’s population is much more concentrated at the coastal areas, and Asia has many large cities on top of a large rural population.

• Current production/capita lies at 12% below 1980 levels.

• The lower 20% of the African population spends 70% of their income on food.

• In 1990, 38% of private wealth was put in foreign accounts, partly due to lack of investment opportunities at home.

• Land ownership is diverse and not always ‘hard’ in a juridical sense.

• African post-colonial culture and policies are ‘away from agriculture’, as opposed to Asia, where major rural development programs were funded that coincided with Green Revolution opportunities offered by rice breeding successes at IRRI.

• Africa did not manage the production and yield jumps observed in Asia (largely increased production per hectare), and South America (largely increased production per manhour).

• Structural adjustment policies in the 1980s and 1990s hit agriculture on the African continent hard. Support for the agricultural sector declines, subsidy schemes had to be abolished, and global support to African agriculture declined sharply. The World Bank Development Report of 2008 admits that it was a wrong policy.

• The African agriculture sector can still not compete well with cheap imports. This is partly due to too low processing capacity, partly due to policies.

At the same time, Africa seems to be finally moving up the ladder. This is proven by a number of macro-economic developments:

• Foreign Direct Investment grew tenfold in the past 10 years to 60 billion $ in 2010

• Fiscal policies improve: tax collection goes up, whereas inflation, government debt, and annual budget deficits go down

• People spend more money, showing that a middle-class is developing.

• Export is moving up: trade went up by 200% since 2000

• Aid is currently at a level of approximately 30 billion US$ (2010)

• Almost every African has a mobile phone.
2. Agronomic context

It is important to know the major farming systems in Sub-Saharan Africa. The book by Dixon et al. (2001) provides the necessary information at a suitable scale (Figure 1).

Figure 1. Farming systems in Sub-Saharan Africa (Dixon et al., 2001)

In a following step, students could zero in on part of the continent, and study, for example, West Africa (Figure 2). The added value of this scale is that the region clearly has agro-ecological zones stretching east-west, allowing to partition the region into e.g., three relevant zones for production: Sahel, Guinea Savanna Zone and Equatorial Forest Zone. Also for the ECOWAS region, such a subdivision has relevance.
A next step can then be, quantitative analysis of soil properties at different scales, i.e., comparing soil quality indicators in Europe and Africa (Table 1), the response of fertilizers in different soils in Kenya and different locations from the village area in Burkina Faso (Table 2), or the long-term effect of fertilizer and manure treatments on soil organic carbon at experimental sites (Table 3). The more sociological entry point is to discuss at village level how villagers value their land (soil fertility, erosion hazard, workability, etc.; Figure 3).

### Table 1. Soil organic carbon and pH in European and African soils

<table>
<thead>
<tr>
<th></th>
<th>Europe</th>
<th>Sub-Saharan Africa</th>
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<tbody>
<tr>
<td></td>
<td>Carbon (%)</td>
<td>pH</td>
</tr>
<tr>
<td>Cambisols</td>
<td>2.6</td>
<td>6.3</td>
</tr>
<tr>
<td>Chernozems</td>
<td>2.2</td>
<td>7.4</td>
</tr>
<tr>
<td>Luvisols</td>
<td>1.8</td>
<td>6.2</td>
</tr>
</tbody>
</table>
Spatial and agronomic efficiency

• KENYA (maize)
  – Kisii volcanic 22 P 2100-4900
  – Homa Bay black 50 N 4500-6300
  – Coastal sands 22 P+50 N 2600-3700

• MALI (millet)
  – Home fields 20 P+38 N 1100-1700
  – Bush fields 20 P+38 N 500-1000

Table 2. Maize (Kenya) and millet (Burkina Faso) yields under different fertilizer regimes in different soils and spatial positions

Effect of inputs in Burkina West

Org. C %, long-term experiment (10 years)

• Year 0 0.45
• No fertilizer 0.19
• Cotton fertilizer 0.23
• Cotton fertilizer + 2,5 t/ha manure 0.36

Table 3. Soil organic carbon in a 10-year trial in Burkina Faso under different fertilizer and manure regimes

3. Chains, cycles and scales

Thinking in terms of chains and cycles is crucial for a good understanding of the agricultural sector. Chapter 4 deals with the economic and societal chain. Here the example is given of an environmental – agronomic chain: soybean being grown in Brazil and ending up in restaurants in Europe and China. Figure 3 shows the components of the chain, which were quantified by Smaling et al. (2008) to assess nitrogen flows and losses between the point of growing soybean to the sewerage system far away from the production site.
Next, the power of geographic information systems can be addressed. Figure 4 shows how the soybean area in Brazil was extended in the period between 1993 and 2005. This was possible thanks to good spatial and tabular data collection systems at the municipality level. Similarly, developments in soy yield could be traced and depicted along the lines of Figure 4.
Figure 4. Expansion of soybean cultivation in Brazil 1993-2005, Phase 1 and 2 of Figure 3.

The next step (Figure 5) is to find out where soybean products end up, once removed from the field, and processed to a certain degree for consumption purposes.

Figure 5. Destination of Brazilian soybean products after harvest; Phase 3 of Figure 3

Finally, the fate of nitrogen in soybean can be calculated using models that convert soybeans into, amongst others, meat, manure and human waste (Figure 6).
Figure 6. Nitrogen flows in Phases 4 (Figure 3) in Gg N year⁻¹: N in food, N for recycling, and N lost to the environment.
4. Policies, legal frameworks, markets and prices

Increasing food prices are much in the limelight over the past couple of years. Figure 7 however shows that food prices have gone down continuously since the 1960s. Hence, food as a commodity has become relatively cheap as a result of major production increases since that time, and competition at the level of producers and retailers. Figure 8 however shows that the past few years, food prices have indeed skyrocketed.

Figure 7. Food price development 1960-2000.

Figure 8. Recent food price developments
The following causes are given for the current price increases:

- Demand – supply disconnect
- Droughts, floods, forest fires
- Biofuels
- Scarcity of resources such as P, energy
- Speculation
- Policies

Also, a series of effects are generally mentioned:

- Exporter: can/is not willing not deliver, satisfies own population first
- Importer: high prices, unrest, Arabic spring, food aid
- Rich importers turn to "land grabbing"
- 42 billion ha (2009), of which ¾ in Sub-Saharan Africa

Price increases for food constitute a serious risk to countries that are large net importers. Since food is such a basic commodity, governments can simply not avoid major shortages. Poor people already spending much of their resources on food will be affected most strongly. Table 4 shows that countries can be grouped into those with a strong import and those with a strong export surplus, both in terms of total agricultural value and in terms of cereals. The Table shows that Arab and West-Asian countries tend to be the major importers. This explains their active role on the ‘land’ market in Africa. The Table also shows that southern hemisphere countries Argentina and Australia are net exporters. Drought, floods and cold weather in the part of the year when these countries are supposed to produce and export can cause serious disruptions to food stocks and prices.

<table>
<thead>
<tr>
<th>Country</th>
<th>2008 in million US $</th>
<th>Total agricultural value</th>
<th>Cereals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>import</td>
<td>export</td>
</tr>
<tr>
<td>Algeria</td>
<td>7.785</td>
<td>76</td>
<td>3.624</td>
</tr>
<tr>
<td>China</td>
<td>80.960</td>
<td>35.903</td>
<td>2.831</td>
</tr>
<tr>
<td>Egypt</td>
<td>8.661</td>
<td>1.823</td>
<td>3.510</td>
</tr>
<tr>
<td>Japan</td>
<td>56.664</td>
<td>2.740</td>
<td>10.366</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>12.266</td>
<td>1.314</td>
<td>4.040</td>
</tr>
<tr>
<td>Country</td>
<td>Export Value</td>
<td>Import Value</td>
<td>Agricultural Value</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------</td>
<td>--------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Ghana</td>
<td>1.311</td>
<td>1.532</td>
<td>452</td>
</tr>
<tr>
<td>Nigeria</td>
<td>3.400</td>
<td>856</td>
<td>773</td>
</tr>
<tr>
<td>Senegal</td>
<td>1.793</td>
<td>252</td>
<td>863</td>
</tr>
<tr>
<td>Argentina</td>
<td>2.814</td>
<td>35.712</td>
<td>33</td>
</tr>
<tr>
<td>Australia</td>
<td>8.356</td>
<td>24.066</td>
<td>179</td>
</tr>
<tr>
<td>India</td>
<td>9.141</td>
<td>17.307</td>
<td>12</td>
</tr>
<tr>
<td>Netherlands</td>
<td>49.542</td>
<td>79.045</td>
<td>3.584</td>
</tr>
<tr>
<td>United States of America</td>
<td>82.442</td>
<td>118.281</td>
<td>2.934</td>
</tr>
</tbody>
</table>

Table 4. Import-export agricultural value for a set of countries (source: FAO Statistics)

Solving the above imbalances, is not an easy thing to do. This is also because the general philosophy is that food trade should be left to a free market. However, this market is not free, fair or level. Also, food is not the same as other commodities which can be chosen or rejected by consumers. You need a certain amount of food to survive, and, at the other side of the spectrum, you have to stop eating at some stage. Moreover, both extremes have high public costs of hunger, starvation and obesity-related diseases. The world has no answer yet, looking at the recent roles of major global bodies:

- FAO: takes stock, collects statistical data
- WFP: focus on emergency situations
- WTO: only free trade
- Worldbank: decades of negligence
- EU: mix of inconsistent policies, supporting own producers, disrupting foreign markets
- China: focus on feeding its own population; ban on phosphate fertilizer export
- African Union: promised 10% of GDP to agriculture, but has not lived up to it yet

5. **Realizing a food-secure population**

A curriculum to realize food security could work from four major perspectives:

1. Put more hectares under crops (extensification)
   a. Goes at the expense of forest and biodiversity; and soil quality and fertility
   b. Is there empty land available that is suitable for agriculture?
      i. Steppen soils Ukraine, Russia, Kazakhstan?
      ii. Cerrados, Llanos in Latin America?
iii. Guinea savanna and Miombo woodlands in Africa?

2. Get more crop/animal per production factor (intensification)
   a. Investment needed: higher outputs as a result of higher inputs
   b. For farmers to invest, output/input ratio needs to be attractive
   c. For companies to invest, return on investment needed
      i. High-yielding varieties
      ii. Irrigation, suitable fertilizers
      iii. Cross-bred cattle
      iv. Labor availability
      v. Market to buy the increased production

3. Reduce food losses (increased efficiency)
   a. According to UNEP > 50% of produced food is not eaten!
      i. Western world: too large portions, throwing food away, supermarket food ‘past-the’day’, destruction of food to keep prices at certain level
      ii. Developing world: rotting in the field, poor storage facilities, poor physical and institutional infrastructure

4. Realize better distribution systems and change diets (access and behavior)
   a. Surpluses and deficiencies worldwide: Hunger vs. obesitas
   b. Deficiencies within Africa, within countries: Early warning systems and Buffer stock policies
   c. Agenda setting
      i. Safety-net for the poor, refugees
      ii. Economic development, farmers become entrepreneurs
      iii. Boundary conditions:
         1. Who should do it? Private vs. public
         2. Focus on what? Staples vs. other food and feeds
         3. Which market? Household, local cities, region, world
         4. Conducive environment? E.g. Free trade vs. protection