Competing claims and food security in Ghana and Mali

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Preface

The world population is expected to grow to nine billion by 2050. In combination with increasing wealth and changes in diets and consumption patterns, this will result in strongly increasing demands for food, fibres and energy. In this context, an important challenge for the coming decades will be how to sustainably supply enough food given the limited area of available land and limited natural resources. These resources are often not equally distributed. Changes in land use and the extension or intensification of agricultural land may lead to economic and social tensions and increase the pressure on biodiversity and the other services that ecosystems provide.

This report is part of the BO Competing Claims project, which aims to increase the understanding of processes that govern competitive land use, to elaborate the factors that play a determining role and to assess options for the sustainable use of natural resources in different contexts. The project also aims to contribute to the knowledge base of the Netherlands Ministry of Economic Affairs, Agriculture and Innovation, so that it may apply the policy principles drafted in its policy note on food security (2008). The project directly addresses issues related to the UN Millennium Development Goals, the Convention on Biological Diversity, the Convention on Sustainable Development (CSD 17) and The Hague Conference on Agriculture, Food Security and Climate Change (October/November 2010).

The authors of this report address the extent to which competing claims on land and water hamper domestic food production, and the major reasons behind these competing claims. They also identify a number of ways to enhance the growth of sustainable food production in these two countries.

Ghana and Mali are partner countries in the Dutch development cooperation policy, and their food security is seriously at stake.

This assignment for the Netherlands Ministry of Economic Affairs, Agriculture and Innovation was carried out by a Wageningen UR team that comprised researchers from various disciplines at Alterra, LEI, ISRIC and PRI. More project results are available in the LEI and Alterra series of reports.

Prof. R.B.M. Huirne
Managing Director LEI

Summary

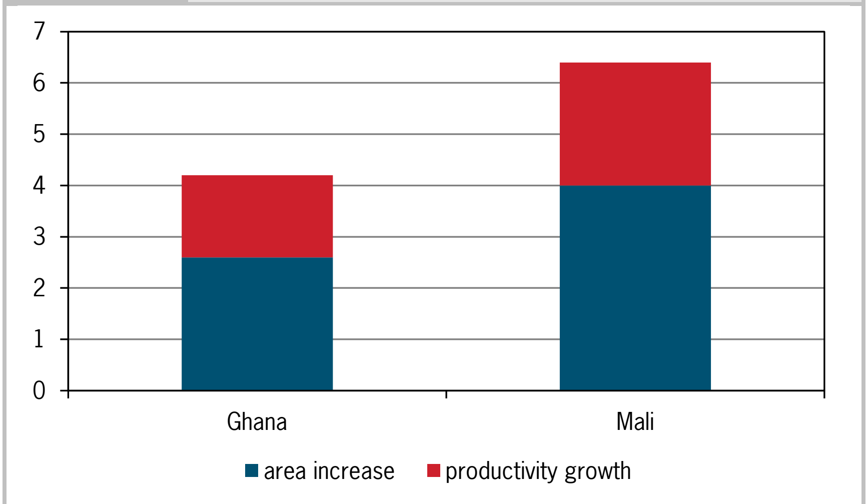
S.1 Key results

Food production rose and the number of undernourished people fell in both Ghana and Mali, mainly as a result of an increase in the area of agricultural land but also as a result of increased agricultural production per hectare (see Figure S.1).

The increase in agricultural areas in these two countries has been at the cost of forest area (Ghana) and wetlands/savannah (in Mali).

As a consequence, there is a clear trade-off between increased food production and ecosystem degradation: there has been a loss of biodiversity in both countries, while livelihood activities in forests in Ghana and in wetlands downstream of irrigation dams in Mali are threatened.

Figure S.1 **Production growth, and the contribution of area increase and productivity growth to production growth in Ghana and Mali**



Source: Own calculations, based on FAO data

S.2 Complementary findings

Undernourishment in both Ghana and Mali was reduced in the period 2000-07, yet is still significant in certain regions in each country (see Section 2.2).

Actual yields in Ghana and Mali are much lower than potentials. The main cause of the yield gap is a lack of nutrients, not of water (see Section 3.3)

Yield improvements are most effective in reducing competing claims on land, but are not likely to be obtained easily. High variability in rainfall, diversity in soil characteristics, uncertain land tenure/ownership positions, and limited market access for inputs and outputs are some of the main underlying causes of farmers being uncertain whether investments in yield improvements will be profitable (see Section 3.4).

Reducing farmers' uncertainties about whether productivity improving investments will be profitable, may be an important response to the problem of reducing competing claims on land and water between different groups and regions, and of alleviating pressure on natural ecosystems. There are many ways to help farmers reduce these uncertainties and increase their productivity in rain-fed production systems without the need for them to make several large investments at the same time (see Section 6.2).

Whatever solution or policy intervention is used to address competing claims on natural resources, there will always be conflicting interests among the stakeholders. The key to reducing these conflicts is to promote dialogue with the various stakeholders in order to bring forward possible ways to reduce trade-offs between claims on natural resources. This calls for a strategy and an operational plan to improve sustainable food production in countries like Ghana and Mali where serious competing claims on natural resources have been identified (see Chapter 4 and Chapter 5).

S.3 Methodology

Food security is seriously at stake in Ghana and Mali, which are partner countries in the Dutch development cooperation policy. This report addresses the extent to which competing claims on land and water hamper domestic food production, and the major reasons behind these competing claims. The study also identifies a number of ways to enhance sustainable food production growth in these two countries. The report is based on a literature review and data analyses.

Samenvatting

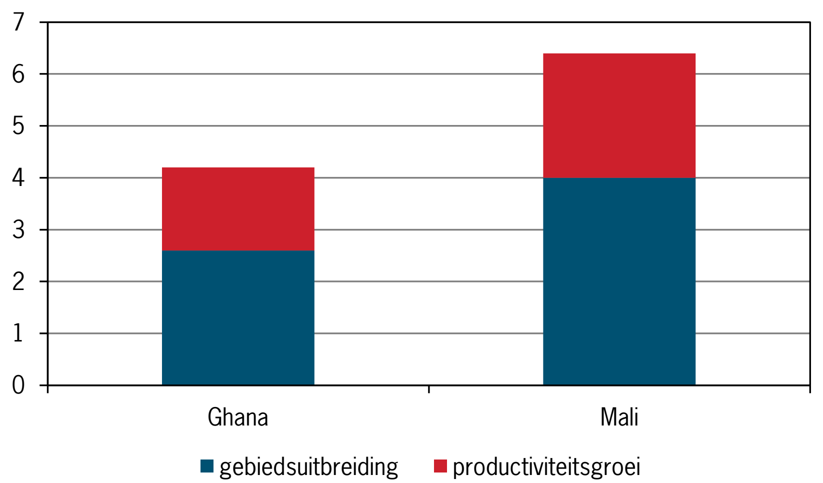
S.1 Belangrijkste uitkomsten

Zowel in Ghana als in Mali is de voedselproductie toegenomen en het aantal gevallen van ondervoeding afgenomen door een combinatie vaneen hogere productie per hectare en uitbreiding van het landbouwgebied. Hierbij is de laatste factor dominant (zie Figuur S.1).

De uitbreiding van landbouwgebieden in beide landen is ten koste gegaan van bosgebied (in Ghana) en wetlands/savanne (in Mali).

Als gevolg daarvan is er een duidelijk verband zichtbaar tussen een toegenomen voedselproductie en een degradatie van het ecosysteem, dat wil zeggen: verlies aan biodiversiteit in beide landen, waarbij de bosbewoners van Ghana in hun levensonderhoud worden bedreigd en de afwaartse stroom van de irrigatiedammen in de wetlands van Mali wordt gehinderd.

Figuur S.1 **Productiegroei en de bijdrage van gebiedsuitbreiding en productiviteitsgroei daaraan in Ghana en Mali**



Bron: Eigen berekeningen, gebaseerd op FAO data

S.2 Overige uitkomsten

In de periode 2000-2007 is het aantal gevallen van ondervoeding zowel in Ghana als in Mali afgenomen, hoewel ondervoeding een groot probleem in bepaalde regio's van beide landen blijft vormen.

De feitelijke productiviteit in Ghana en Mali is aanzienlijk lager dan de potentiële productiviteit. De hoofdoorzaak hiervoor is gelegen in de beschikbaarheid van nutriënten, niet van water.

Verbetering van de productiviteit vormt een belangrijke manier om het aantal strijdige claims op land te verminderen, hoewel dit waarschijnlijk niet eenvoudig zal zijn. Een hoge variabiliteit in neerslag, diversiteit in bodemkenmerken, onzekere positie als grondpachter/grondeigenaar en beperkte markttoegang (voor inputs en outputs) vormen enkele van de onderliggende oorzaken voor de onzekerheid van boeren of investeringen in productiviteitsverbetering wel hun vruchten zullen afwerpen.

Door ervoor te zorgen dat boeren minder onzeker zijn over de winstgevendheid van hun investeringen in productiviteitsverbetering, kan het aantal strijdige claims van diverse groepen en regio's op land en water mogelijk afnemen en de druk op natuurlijke ecosystemen worden verlicht. Er zijn veel opties voorhanden om boeren te helpen deze onzekerheden te verminderen en hun productiviteit in regenafhankelijke productiesystemen te verhogen zonder grote investeringen van de kant van deze boeren.

Ongeacht welke oplossing of beleidsinterventie wordt gekozen voor de aanpak van strijdige claims op natuurlijke bronnen, zullen er altijd conflicterende belangen onder de betrokken partijen bestaan. Om deze conflicten te beperken is het van cruciaal belang dat de diverse belanghebbenden de dialoog met elkaar aangaan om mogelijke oplossingen aan te dragen teneinde de trade-offs tussen claims op natuurlijke bronnen te reduceren. Dit vraagt om een strategie en een operationeel plan om duurzame voedselproductie te verbeteren in landen als Ghana en Mali waar serieuze strijdige claims op natuurlijke bronnen zijn vastgesteld.

S.3 Methode

In Ghana en Mali, partnerlanden in het Nederlands beleid voor ontwikkelingssamenwerking, is de voedselveiligheid ernstig in de verdrukking gekomen. In dit rapport wordt besproken in welke mate strijdige claims op land en water de binnenlandse voedselproductie hinderen en wat de belangrijkste redenen achter deze strijdige claims zijn. In het onderzoek wordt tevens een aantal manieren vastgesteld waarop de groei van duurzame voedselproductie in deze twee landen kan worden gestimuleerd. Het rapport is gebaseerd op literatuur-onderzoek en data-analyses.

1 Introduction

1.1 Background and rationale for focusing on Ghana and Mali

Ghana and Mali are listed as partner countries in the Dutch development cooperation policy letter (Focusbrief Ontwikkelingssamenwerking, 2011). Food security is seriously at stake in these two countries: according to the global hunger index[1] of the IFPR (2011), both encounter frequent food shortages.[2] Both countries have an increasing population and a vulnerable agro-ecological environment: the climate and vegetation in most parts of these two countries are similar to that in other Sahelian countries, with crops and livestock suffering from dry periods and increasingly rainy seasons with erratic rainfall. FAO data indicate that population growth has exceeded agricultural productivity growth in recent years, implying the need to expand agricultural land in and/or food imports by these countries in order to keep up with their food needs.

A major condition for food security is adequate and stable food production. The latter depends on natural conditions and a whole complex of economic, social, technological and institutional factors that affect the opportunities and decisions to exploit the available resources. The question addressed in this report is the extent to which domestic food production in the two countries is hampered by competing claims on land and water that can or could be used to produce agricultural crops or livestock products. The aim of the report is to explain the reasons behind the countries' inability to use these resources most efficiently and how the countries' possibilities to improve their food security are limited by competing claims on the available land and water. The report identifies a number of ways to enhance the growth of sustainable food production.

[1] The GHI captures three dimensions of hunger: insufficient availability of calories, shortfalls in the nutritional status of children, and child mortality.
[2] Although Ghana is among the ten countries that have most improved their GHI scores since 1990 (and is the only country in sub-Saharan Africa to have done so) Mali, though, is one of the countries with the highest child mortality rates in the world (IFPRI, 2011 GHI report).

1.2 Research questions

In order to answer the question how to address competing claims on land and water for food and biodiversity, the following research questions are addressed in each of the two case studies:

1. What are the domestic food needs and how are they supplied?
2. What is the agronomic potential for food production and what are the major bottlenecks to the efficient use of the food production potentials?
3. What competing claims on land and water for food, feed, fuel and ecosystem services (forest, nature, ecologically vulnerable areas) have been identified, and what are the underlying driving factors?
4. How can these competing claims be addressed? Is there a role for international (Dutch/EU) intervention to ease the claim on non-agricultural land for food/feed production? Which measures to increase food security may best help to reduce competing claims on natural resources?

1.3 Approach

To establish the demand and domestic supply of food and agricultural products in the two countries, a brief description of the basic features of each country's food consumption patterns and agricultural economy is required. Statistics on population and food consumption per capita (and major food items consumed) provide an insight into current consumption levels, while a comparison of calorie intakes at these levels with what is needed for a healthy and productive life indicates the actual shortage of food in a nutrition and health perspective. Food supply either comes from domestic production or is imported. National production and trade statistics are used to present each country's food import dependency. At the same time, Mali and Ghana may be exporting agricultural commodities. The country's trade position therefore indicates the competitive position of these countries' agricultural sectors.

Agricultural production potentials may be seriously limited by agronomic bottlenecks. The literature on and data analyses of soil fertility, rainfall, pests and diseases and other relevant factors were used to identify where such bottlenecks occur, the possible ways to overcome limiting factors and what the full potential of agricultural production might be if these solutions prove effective.

While agro-ecological bottlenecks to increasing production may be tackled by interventions focusing on water management and/or other measures to improve soil fertility, economic factors such as commodity and input prices and access to markets may be important reasons hampering the agricultural production potentials to be realised. Local farmers' decisions on what to produce and how (using inputs like fertilisers, land, labour and capital; indicating the technology level used in the local production system) are based on the local prices of the major agricultural outputs (crops, animal products) and inputs (fertilisers, labour, credit, et cetera). However, due to weather, pests and diseases, harvests are highly precarious and therefore farmers apply risk avoidance strategies and may not make economically optimal decisions.

The use of land for food and non-food products (such as ecosystem services) is determined by economic forces, legislative rules, and traditions, and by the social power dynamics between local stakeholders. The case studies serve to deepen our understanding of how decision making on the use of land takes place. In order to understand situations of competing or potentially competing claims, it was necessary to have a thorough overview of the various stakeholders. Socio-political power networks are relevant, on various scales (local, regional, et cetera). Although, far from transparent, they define local decision making and its outcomes. This part of the case study applies the DPSIR approach of describing and analysing the drivers, pressures, state, impacts and responses to competing claims on land identified in the two countries selected.

In terms of solutions to the competing claims identified, several measures to relieve pressure on land use are discussed and evaluated. The measures aim at increasing food production while preserving biodiversity and ecologically vulnerable areas.

2 Food needs and supply in Ghana and Mali

2.1 Food needs and supply in Ghana

2.1.1 Key indicators of agriculture and poverty in Ghana

Ghana has experienced profound growth and development over the last two decades. Between 1990 and 2007, the economy grew by over 4 per cent annually, resulting in an almost doubling of GDP in constant prices (see Table 2.1). This has resulted in a substantial fall in poverty levels, which means that Ghana is well on track to achieve the MDG 1 target of reducing by half the proportion of its population living in extreme poverty by 2015. Agricultural GDP (not presented in Table 2.1) grew by 4.3 per cent in 2007 and by 5.1 per cent in 2008; the provisional outlook for 2009 and 2010 indicates an increase of 5.7 per cent and 6.0 per cent, respectively.[1] Although the share of agriculture value added has been decreasing over time, from 35.7 per cent in 2005-07, the sector is still a key driver of total economic growth. With more than half of the population being active in agriculture, it also remains the primary livelihood for the majority of the population, in particular the poor.

[1] Appendices for 2010 budget statement and economic policy, http://www.mofep.gov.gh/documents/appendices2010.pdf (13-04-11).

Table 2.1	Agriculture, macro-economic and poverty statistics in Ghana							
		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Total population	1,000	15,407	17,702	20,001	22,393	2.8	2.4	2.3
National poverty headcount	Per cent	50.0*		39.5**	28.5***			
Share of food in total expenditure	Per cent				51***			
GDP at market prices (constant 2,000 USD)	MLN USD	3,426	4,211	5,188	6,764	4.1	4.2	5.3
Share of agri-culture value added in total GDP	Per cent	45	37.8	35.2	35.7	-3.5	-1.4	0.2
Share of agri-cultural labour force	Per cent	59.2	58.0	56.8	55.5	-0.4	-0.4	-0.5

Note: *1992; **1999, ***2006.
Source: Ghana Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Ghana_E.pdf (12-04-11). National poverty headcount from MDG indicators, http://mdgs.un.org/unsd/mdg/Default.aspx (12-04-11).

2.1.2 Food demand

Table 2.2 summarises several key indicators on food deprivation and food consumption in Ghana for the period 1992-2007. The figures show that rapid economic growth and development have resulted in a substantial improvement in food security conditions. The proportion of undernourished population decreased from 27 per cent in 1990-92 to 5 per cent in 2005-07. In absolute figures, the number of undernourished people dropped from 4.2 million to 1.2 million over the same period.

The intensity of food deprivation shows by how much food-deprived people fall short of minimum food needs in terms of dietary energy. The intensity is defined as the difference between the minimum dietary energy and the average dietary energy consumption of the undernourished population (food-deprived). According to the FAO, the intensity of food deprivation is low when it is less than

200 kilocalories per person per day, and high when it is more than 300 kilocalories per person per day.[1] The table shows that the intensity of food deprivation has decreased from a deficit of 250 kcal per person per day to a 'low' figure of 180 kcal per person per day.

The dietary energy supply (DES) is derived from the national 'food balance sheets' compiled by the FAO every year. These sheets provide estimates of how much of each food commodity a country produces, imports and withdraws from stocks for other non-food purposes. The FAO then divides the energy equivalent of all the food available for human consumption by the total population to come up with average daily energy supply. Actual food consumption may be lower than food availability due to wastage and losses of food in the household (e.g. during storage, in preparation and cooking, quantities fed to domestic animals and pets, thrown or given away). The top five food commodities measured by their share in DES are cassava, maize flour, yams, plantains and broken rice. The figures also reveal a structural shift in the pattern of food consumption from cassava and maize flour to broken rice. The former decreased from almost 40 per cent to just over 32 per cent, while the latter (broken rice) increased from zero to 5.3 per cent over the reviewed period.

Table 2.2 Food deprivation and consumption indicators

		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97(%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Food deprivation								
Proportion of undernourished	Per cent	27	12	9	5	-16	-6.2	-10.8
Number of undernourished	Millions	4.2	2.2	1.8	1.2	-13.2	-3.7	-10.7
Food deficit of undernourished population	kcal/ person/ day	250	210	200	180	-3.8	-1.0	-1.6

Source: Ghana Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Ghana_E.pdf (12–04–11).

[1] http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/ (12-04-11).

Table 2.2	**Food deprivation and consumption indicators (continued)**							
		1990-92	**1995-97**	**2000-02**	**2005-07**	**1990-02 to 1995-97(%)**	**1995-97 to 2000-02 (%)**	**2000-02 to 2005-07 (%)**
Food supply for human consumption								
Dietary energy supply (DES)	kcal/ person/ day	2,120	2,480	2,630	2,850	3.1	1.1	1.6
Major food commodities consumed (share in DES) - ranked on the latest 4-year period								
1 - Cassava	Per cent	23.6	27.4	23.7	20.5	2.9	-2.9	-2.8
2 - Maize flour	Per cent	16.0	15.0	12.8	12.0	-1.2	-3.1	-1.4
3 - Yams	Per cent	8.1	10.5	12.2	11.1	5.1	3.1	-2.0
4 - Plantains	Per cent	6.8	8.8	8.7	9.9	5.0	-0.1	2.4
5 - Rice, broken	Per cent	0.0	0.1	2.2	5.3		53.9	18.0
Share of cereals and roots and tubers in DES	Per cent	70.9	73.0	71.4	66.7	0.6	-0.4	-1.4
Share of oils and fats in DES	Per cent	7.5	5.2	5.7	7.3	-7.3	1.9	5.0
Source: Ghana Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Ghana_E.pdf (12–04–11).								

2.1.3 Food supply

Parallel to economic growth and reduction in poverty, food production per person in Ghana measured as an index with base year 1999-01 increased from 77 in 1990-02 to 113 in 2005-07 (Table 2.3). The country is almost self-sufficient in the production of major food crops. The ratio of production to consumption is more than double for cassava (the major staple food) and over 100 per cent for maize flour, yams and plantains.[1] In contrast, the available information suggests that the country is dependent on imports to fulfil the domestic demand for rice. Although the FAO data is patchy, the table shows that local production is

[1] Note that the ratio for plantains is stable over time and therefore might not be reliable. Also note that FAO data may not include the non-timber forest food products such as bush meat, fruits, et cetera. These products are an important part of the population's food intake in certain regions of the country. Fish is an important part of the Ghanaian diet (see Section 4.2) but is not mentioned in the statistics in Table 2.3.

negligible and that more than 100 per cent of total consumption is imported. This is corroborated by the more detailed food and supply and demand analysis in WFP (2009, p. 37) for 2007/2008, which shows a deficit of more than 70 per cent of total rice consumption. For all other commodities, domestic food supply far exceeds demand. Overall food availability at the national level is adequate and therefore does not contribute to the food insecurity and the undernourishment that still exist in some regions in Ghana.

Table 2.3 Food supply and trade indicators

		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Food production indicators								
Per person food production index	1999-01 =100	77	92	103	113	3.6	2.3	1.9
Ratio of production to consumption by major commodity								
1 - Cassava	Per cent	182.6	172.8	216.8	221.3	-1.1	4.5	0.4
2 - Maize flour	Per cent	102.0	102.0	106.9	105.3	0.0	0.9	-0.3
3 - Yams	Per cent	201.2	134.7	153.9	148.5	-8.0	2.7	-0.7
4 - Plantains	Per cent	111.1	111.1	111.1	111.1	0.0	0.0	0.0
5 - Rice, broken	Per cent		0.0	0.0	0.0			
Foreign food trade								
Ratio of imports to consumption by major commodity								
1 - Cassava	Per cent							
2 - Maize flour	Per cent	0.0	0.0	0.1	0.0		1.6	-3.4
3 - Yams	Per cent							
4 - Plantains	Per cent							
5 - Rice, broken	Per cent			112.3	83.8			-5.9

Source: Ghana Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Ghana_E.pdf (12-04-11).

Table 2.3	Food supply and trade indicators (continued)							
		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Total exports	MLN USD	960	1497	1865	3537	8.9	4.4	12.8
Share of food in total exports	Per cent	37.3	36.5	28.7	38.1	-0.4	-4.8	5.7
Share in total DES production	Per cent	5.6	6.4	6.3	10	2.6	-0.2	9.4
Total imports	MLN USD	1,327	1,918	2,936	6,386	7.4	8.5	15.5
Share of food in total imports	Per cent	14.9	8.3	11.9	14.3	-11.8	7.2	3.7
Share in total DES production	Per cent	8.7	4.9	9.4	16.7	-11.3	13	11.4
Net food trade in total GDP	Per cent	2.5	5.7	3.4	3.4	16.3	-10.5	0

Source: Ghana Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Ghana_E.pdf (12-04-11).

2.1.4 Regional differences in food supply and demand in Ghana

Ghana is divided into ten administrative zones: Greater Accra, Central, Western, Brong-Ahafo, Northern, Upper West, Upper East, Volta, Eastern and Ashanti. There are three agro-ecological zones - coastal, forest and savannah - which cut across the administrative regions and can be further divided into sub-zones. Each zone differs in terms of average annual rainfall, type of vegetation, soil and type of agriculture, which have a large impact on local livelihoods.

There are important regional differences in food production and consumption. Roots and tubers (cassava and yams) are mainly cultivated in the southern regions, while cereals (maize, millet, sorghum and rice) are predominantly grown and consumed in the northern parts. These differences are shown in Table 2.4, which presents data on the average production of staple foods per region. Of the ten regions, Brong-Ahafo, Eastern and Ashanti are the most important for food production. Roots, tubers and plantain are the dominant staple crops. With an annual average of 752 MT (39%), the three northern regions (Northern, Upper West and Upper East) were responsible for the majority of Ghana's annual cereal production between 2000 and 2008.

Ghana does not face significant food deficits and enjoys surpluses in certain commodities (see Table 2.4). However, in the Northern, Upper East and Upper West regions, 10 per cent, 15 per cent and 34 per cent of the respective households are currently food insecure. Vulnerability to food insecurity is also observed in some other regions, such as Ashanti and Brong-Ahafo.

Table 2.4 **Annual average production of staple food by region, 2000-08**

	Total production (MT)	Cereals (MT)	Roots/tubers/plantain (MT)
Brong-Ahafo	5,124,778	327,44	4,797,338
Eastern	4,515,276	260,923	4,254,353
Ashanti	3,019,845	197,649	2,822,196
Central	2,004,307	192,848	1,811,458
Western	1,675,111	101,122	1,573,988
Volta	1,576,357	103,676	1,472,680
Northern	1,511,653	297,144	1,214,509
Upper West	469,81	208,593	261,217
Upper East	245,983	245,983	-
Greater Accra	65,657	8,014	57,643
Total	20,208,777	1,943,393	18,265,383

Source: WHO, Republic of Ghana, Comprehensive food security and vulnerability analysis (2009).

2.2 Food needs and supply in Mali

2.2.1 Key indicators of agriculture and poverty in Mali

The latest poverty figure for Mali (1998) shows that almost two thirds of the population is living below the national poverty line (see Table 2.5). The livelihoods of most of the poor are dependent on the agricultural sector, which accounts for 37 per cent of GDP and 77 per cent of the total labour force. Nonetheless, the same indicators also show that the importance of agriculture in the economy decreased slightly between 1990 and 2007.

Table 2.5	Agriculture, macro-economic and poverty statistics in Mali							
		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Total population	1,000	8,829	9,732	10,764	12,120	1.9	2	2.4
National poverty headcount	Per cent		63.8*					
Share of food in total expenditure	Per cent			66.5**				
GDP at market prices (constant 2,000 USD)	MLN USD	1,694	1,966	2,655	3,460	3.0	6.0	5.3
Share of agriculture value added in total GDP	Per cent	45.6	48.6	38.1	36.7	1.3	-4.9	-0.8
Share of agricultural labour force in total labour force	Per cent	84.7	82.6	80.2	77.4	-0.5	-0.6	-0.7

Note: *1998; **2003.
Source: Mali Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Mali_E.pdf (12-04-11). National poverty headcount from MDG indicators, http://mdgs.un.org/unsd/mdg/Default.aspx (12-04-11).

2.2.2 Food demand

The available figures indicate that undernourishment in Mali more than halved from 27 per cent in 1990-92 to 12 per cent in 2005-7 (Table 2.6). The decrease was particularly sharp after 1995 with a reduction of around 7 per cent per year. Over the same period, the total number of undernourished people decreased from 2.4 to 1.5 million. The intensity of food deprivation also dropped from 270 to 220 kcal per day, which is still above the 'low' threshold defined by the FAO (i.e. 200 kcal per day).

The five major food crops in Mali are millet, rice, sorghum, maize and sugar, with shares of 20, 14, 13, 9 and 5 per cent in DES, respectively, in 2005-07. The relative large share of rice, accompanied with a decrease in the consumption of sorghum, is a feature of the last decade only. In 1990-92, sorghum accounted for more than 22 per cent of DES while rice made up only 9 per cent. Cereals, roots and tubers account for 70 per cent of DES.

Table 2.6	Food deprivation and consumption indicators							
		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Food deprivation								
Proportion of undernourished	Per cent	27	25	18	12	-1.3	-6.7	-8.1
Number of undernourished	millions	2.4	2.5	1.9	1.5	0.7	-4.7	-7.2
Food deficit of undernourished population	kcal/person/day	270	260	240	220	-0.4	-1.7	-1.7
Food supply for human consumption								
Dietary energy supply (DES)	kcal/person/day	2,180	2,220	2,390	2,580	0.3	1.5	1.6
Major food commodities consumed (share in DES) - ranked on the latest 4-year period								
1 - Millet flour	Per cent	23.8	22.3	20.2	20	-1.3	-1.9	-0.2
2 - Rice, husked	Per cent	9.3	12.5	14.5	14.2	5.9	3	-0.4
3 - Sorghum flour	Per cent	22.2	19.1	14.6	13.4	-3	-5.3	-1.7
4 - Maize flour	Per cent	7.1	9	9.1	8.7	4.7	0.3	-1
5 - Sugar, refined	Per cent	4.2	4.8	5	4.9	2.7	0.6	-0.3
Share of cereals and roots and tubers in DES	Per cent	69.4	70.8	69.8	70.2	0.4	-0.3	0.1
Share of oils and fats in DES	Per cent	9.3	7.5	8.2	7.8	-4.2	1.9	-1.1

Source: Mali Country Profile - Food Security indicators (October 2010). http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Mali_E.pdf (12-04-11).

2.2.3 Food supply

Based on an index of 100 in 1999-2001, total food production per person increased from 97 in 1990-92 to 118 in 2005-07 (Table 2.7). However, a closer look at the figures reveals that all growth occurred over the last five years of this period. Mali is near self-sufficient in the production of major food crops. For millet and sorghum, total domestic production slightly exceeds total consumption, while there is a large surplus for rice. With regard to maize and sugar, demand is greater than production and Mali strongly depends on imports particularly for sugar. Table 2.7 also presents figures for the share of food trade in the national diet expressed in energy units. Since 1990-92, the percentage of imported food in DES production almost doubled from 3.8 to 8.7 per cent. This suggests that to a certain degree, food supply in Mali will be sensitive to fluctuations in international food prices.

Table 2.7 Food supply and trade indicators

		1990-92	1995-97	2000-02	2005-07	1990-02 to 1995-97 (%)	1995-97 to 2000-02 (%)	2000-02 to 2005-07 (%)
Food production indicators								
Per person food production index	1999-2001=100	97	94	97	118	-0.6	0.6	4.0
Ratio of production to consumption by major commodity								
1 - Millet flour	Per cent	102	102	102	102	0	0	0
2 - Rice, husked	Per cent	103.1	99.1	106.6	113.9	-0.8	1.5	1.3
3 - Sorghum flour	Per cent	102	102	102	102	0	0	0
4 - Maize flour	Per cent	97.9	99.8	99.5	97.8	0.4	-0.1	-0.3
5 - Sugar, refined	Per cent	32.9	26.5	22.8	22.1	-4.3	-3	-0.6
Foreign food trade								
Ratio of imports to consumption by major commodity								
1 - Millet flour	Per cent	0.0	0.0	0.0	0.0			
2 - Rice, husked	Per cent	0.0	4.0	0.2	0.2		-62.1	2.9
3 - Sorghum flour	Per cent							
4 - Maize flour	Per cent	2.1	0.2	0.5	2.2	-50.9	22.3	29.3
5 - Sugar, refined	Per cent	67.1	73.5	95.2	94.0	1.8	5.2	-0.3

Source: Mali Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Mali_E.pdf (12-04-11).

Table 2.7	**Food supply and trade indicators (continued)**							
		1990-92	**1995-97**	**2000-02**	**2005-07**	**1990-02 to 1995-97 (%)**	**1995-97 to 2000-02 (%)**	**2000-02 to 2005-07 (%)**
Total exports	MLN USD	345	511	706	1307	7.9	6.4	12.3
Share of food in total exports	Per cent	29.2	17.3	13.3	6.7	-10.4	-5.2	-13.7
Share in total DES production	Per cent	1.0	1.1	0.8	1.1	1.6	-6.2	6.7
Total imports	MLN USD	661	786	907	1,556	3.5	2.9	10.8
Share of food in total imports	Per cent	12.9	10.6	13	15.9	-3.8	4	4
Share in total DES production	Per cent	3.8	4.1	7.6	8.7	1.9	12	2.9
Net food trade in total GDP	Per cent	0.6	0.2	-0.9	-2.6	-22.8		22.4

Source: Mali Country Profile - Food Security indicators, October 2010, http://www.fao.org/fileadmin/templates/ess/documents/food_security_statistics/country_profiles/eng/Mali_E.pdf (12-04-11).

2.2.4 Regional differences in food supply and demand in Mali

Mali is divided into eight regions and one district, which is the capital Bamako. The regions are: Gao, Kayes, Kidal, Koulikoro, Mopti, Ségou, Sikasso, and Tombouctou (Timbuktu). DNA et al. (2007) provide detailed regional information on cereal production by region for 2004-05. Measured by area, Segou and Mopti, followed by Koulikoro and Sikasso, are the most important cereal producing regions (see Table 2.8). Millet and sorghum are the two major cereals, together accounting for 75 per cent of the total cultivated cereals area. Millet alone makes up 50 per cent of total cereals produced. Rice (13 per cent), maize (11 per cent) and fonio (a type of millet) (1 per cent) make up a relatively small share of total cereal supply. Cereals are produced mainly in Ségou, Mopti, Koulikoro and Sikasso with 27, 22, 19 and 17 per cent of the cereal area, respectively. Sikasso stands out as the dominant region for the production of maize.

Table 2.8	Area of Cereal Production by region, 2004-05					
Region	**Millet (%)**	**Sorghum (%)**	**Rice (%)**	**Maize (%)**	**Fonio (%)**	**Total (%)**
Kayes	4	19	1	11	12	8
Koulikoro	17	30	5	18	9	19
Sikasso	9	22	6	59	18	17
Ségou	33	18	36	9	28	27
Mopti	30	6	38	1	33	22
Tombouctou	5	1	7	0	0	4
Gao	2	3	7	0	0	3
Bamako	0	0	0	1	0	0
Total	100	100	100	100	100	100
Total area (ha)	1,184,607	577,020	314,914	252,312	25,303	2,354,156

Table 2.9 provides indicators on poverty and food security for the various regions. Mopti and Sikasso, which are among the most populous areas, have the highest levels of poverty, while Gao/Kidal and Bamako have relatively low levels. In terms of undernourishment, Sikasso and Timbuktu show the highest share of stunting, which refers to the proportion of children under five that have a low height for their age. Stunting is caused by long-term insufficient nutrient intake and frequent infections. The share of wasting (low weight for height), which is a strong predictor for mortality among children under five, is highest in Gao/Kidal and Timbuktu.

Table 2.9	Poverty and undernourishment indicators by region, mid 2000			
Region	**% Total pop.**	**% Poverty**	**% Of stunting**	**% Wasting**
Sikasso	18	83	45	16
Segou	17	71	40	15
Koulikoro	16	75	39	16
Kayes	14	50	31	15
Mopti	15	89	41	13
Timbuktu	5	61	44	17
Gao/Kidal	4	23	~33	~20
Bamako	11	24	23	14
Total	100			

Note: The source is not clear about the year to which the data pertains and the definitions used for wasting and stunting. A standard definition is assumed.
Source: http://www.feedthefuture.gov/documents/MaliFTFStrategicReview.pdf (13-04-11).

As an alternative to the administrative regions, it is possible to draw a livelihood zones map, which divides a country into homogenous zones within which people share broadly the same pattern of livelihood, including access to food and income and patterns of exchange.[1] The zones are defined on the basis of three, mutually interacting factors:

- Geography: includes both natural factors (climate, soil, altitude, climate, vegetation, topography) and man-made factors (roads, railways, telecommunications).
- Production: refers to the various production systems (e.g. agricultural, agropastoral and pastoral systems), which are determined by a range of factors, notably geography, marketing system, financial system and government policy.
- Market access: determines the ability to sell primary production, to trade goods and services, and to find employment. It is influenced by: the existence of demand (e.g. proximity to large urban areas and markets; the efficiency of the marketing system, including the experience of traders, their access to capital, credit and equipment and government policy and legislation affecting trade (e.g. systems of licensing, taxation, duty, et cetera); and infrastructure.

Thirteen livelihood zones can be distinguished in Mali. These are summarised in Table 2.9 and depicted in Figure 2.1.

[1] http://www.fews.net/pages/livelihoods-products.aspx?prd=157&l=en (19-04-11).

Table 2.9	**Livelihood zones in Mali and their food crops**		
Zone	**Rainfall**	**Food crops**	**Note**
1. Nomadism and trans-Saharan trade (desert)	0-200 mm (75 days)	-	Extremely thinly populated and characterised by nomadic livestock rearing
2. Nomadic and transhumant pastoralism	0-200 mm (75 days)	-	Insufficient moisture for crop cultivation; pastoralism the only viable livelihood
3. Fluvial rice and transhumant livestock rearing (agro-pastoral)	150-200 mm	Rice	Food-insecure zone with diversified livelihoods Insufficient rainfall for agriculture except for riverbanks No infrastructure to control the water
4. Millet and transhumant livestock rearing	300-500 mm	Millet and sorghum	Food deficit zone with some surplus generating areas External aid is common
5. Dogon plateau: millet, shallots, wild foods and tourism	400-600 mm	Millet	Structurally in food deficit and a net importer of cereals Onions are an imported cash crop
6. Niger delta/lakes: rice and livestock rearing (agro-pastoral)	300-600 mm	Rice	Food surplus zone
7. 'Office du Niger': irrigated rice	300-500 mm	Rice	Fully-irrigated agricultural zone that specialises in rice growing and market gardening. Rice yields are very high, sometimes surpassing 7 tonnes per ha.
8. North-west: remittances, sorghum and transhumant livestock rearing	400-500 mm	Sorghum, millet	Zone is not agriculture or livestock related but depends heavily on remittances

Source: Livelihood and zoning and profiling report Mali, http://www.fews.net/docs/Publications/ML_profile_en.pdf (19-04-11).

Table 2.9	Livelihood zones in Mali and their food crops (continued)		
Zone	**Rainfall**	**Food crops**	**Note**
9. West and central: rain-fed millet/sorghum	600-800 mm	Sorghum, millet, cowpeas and maize	Moderate population density and primarily characterised by rain-fed agriculture and sedentary livestock rearing
10. Sorghum, millet and cotton	700-1,100 mm	Sorghum, millet and maize	Highly productive food surplus zone
11. South: maize, cotton and fruits	1000-1,300 mm	Maize, sorghum and millet	Highly productive food surplus zone
12. South-west: maize, sorghum and fruits	1,000-1,300 mm	Maize, sorghum and rice	Relatively rich region
13. Bamako	n/a	n/a	n/a

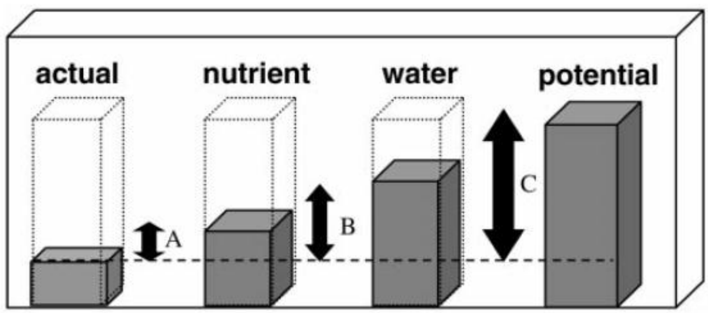
Source: Livelihood and zoning and profiling report Mali, http://www.fews.net/docs/Publications/ML_profile_en.pdf (19-04-11).

3 Agricultural potentials in Ghana and Mali

3.1 Yield gap in productivity

The difference between potential and actual productivity is indicated as the 'yield gap' that must be overcome in order to achieve biophysical maximums (Figure 3.1). The timespan required to overcome the yield gap reveals the required productivity growth rates, the required inputs in agricultural developments and the adaptation of those developments. In the applied methodology, we take the water-limited or rain-fed productivity level as the potential level, and do not take into consideration irrigation.

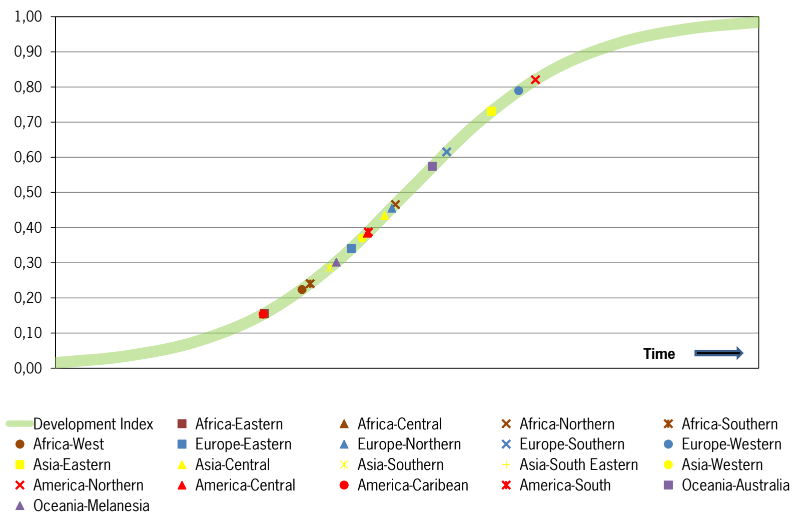
Figure 3.1 Visualisation of the Yield Gap



Source: Bindraban et al. (2000).

The actual productivity level results from socio-economic conditions and crop growth reduction factors such as pests and diseases, leading to Yield Gap A. The nutrient-limited productivity level results from crop growth limitation by available nutrients and nutrient use efficiency, leading to Yield Gap B. Yield Gap B is presented in Figure 3.2 for 19 regions and for Ghana and Mali in the subsequent chapters. The water-limited or rain-fed productivity level results from available water from precipitation, from soil conditions and from water use efficiency, leading to Yield Gap C. The potential productivity level is a result of plant characteristics and weather conditions such as temperature and radiation.

Figure 3.2 **Yield gap B calculated for 19 UN regions**



Source: Jongschaap et al. (2011).

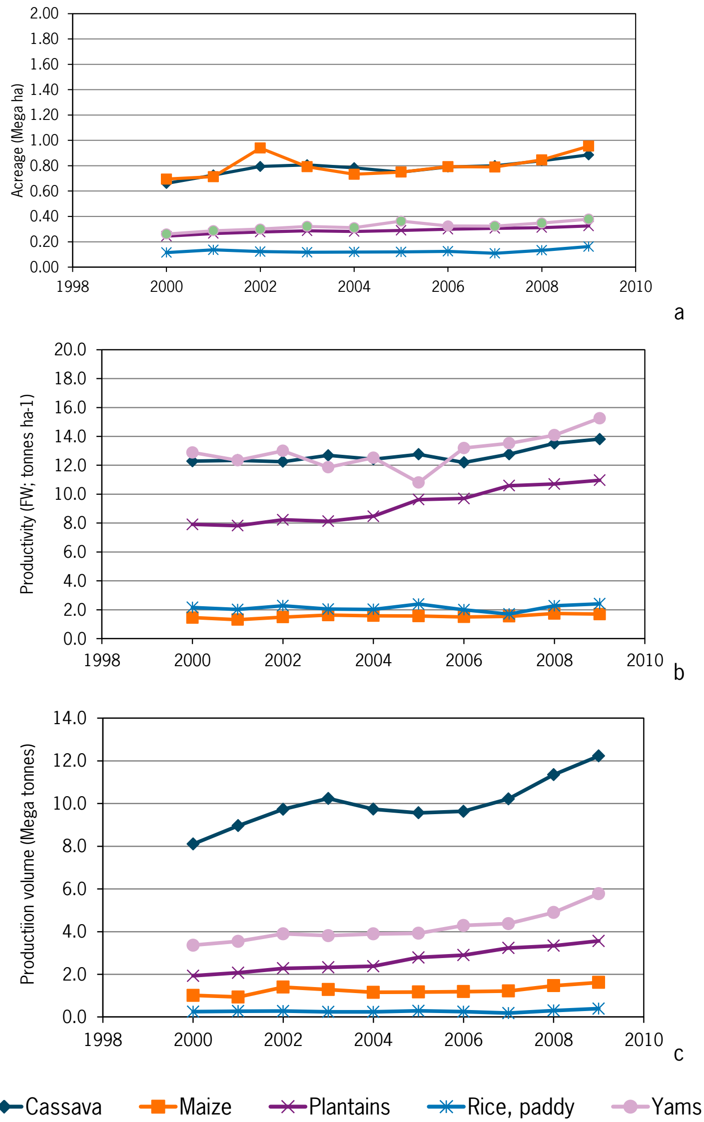
Farmers in Africa cannot take full advantage of the available natural resources that are available for crop growth and production. Based on temperature, precipitation rates and the soil types of the arable land, much higher productivity could be achieved. West Africa uses only 22 per cent of the available resources on its arable land (Jongschaap et al., 2011). Thus, if the potential rain-fed crop productivity were realised, competing claims on land could be reduced by a factor of 4 or 5.

3.2 Ghana

3.2.1 Crop production of major commodities since 2000

The major food commodities in Ghana are cassava, maize, plantains, rice and yams. The development of harvested acreage, productivity and production volumes of these commodities is presented in Figure 3.3.

Figure 3.3	Acreage (a; mega ha^{-1}), Productivity (b; fresh weight tonnes ha^{-1}) and Production volumes (c; fresh weight mega tonnes) of major food commodities in Ghana



Source: FAOStat.

Both the increase of acreage under arable land and permanent cropland and productivity growth per hectare contributed to production growth (Table 3.). The harvested areas of the major food commodities cassava, plantains and yams have increased by more than 2 per cent per year (Figure 3.3a; Table 3.1). The land use change was necessary, as the population growth in Ghana was 2.3 per cent per year since 2000 (Chapter 2), and the productivity increase rates for the major food commodities (except maize and plantains) could not keep pace with this growth (Table 3.1). The increase in harvested area together with the productivity growth have resulted in production volumes that would be sufficient for keeping the food supply per capita at the same level as in 2000. However, changing diets, which have increased the requirements for crop products, and production losses, may have created a situation in which current production volumes are still insufficient to feed the population adequately.

Table 3.1 **Average values for harvested area, productivity and production volumes for the major food commodities in Ghana between 2000-02 and 2007-09**

	Harvested area (mega ha)			Productivity (tonnes ha^{-1})			Production volume (mega tonnes)		
	2000-02	2007-09	(% y^{-1})	2000-02	2007-09	(% y^{-1})	2000-02	2007-09	(% y^{-1})
Cassava	0.73	0.84	2.3	12.29	13.36	1.2	8.93	11.27	3.7
Maize	0.78	0.86	1.5	1.42	1.66	2.4	1.12	1.44	4.1
Plantains	0.26	0.31	2.8	7.99	10.75	4.9	2.10	3.38	8.7
Rice	0.12	0.13	1.1	2.15	2.13	-0.1	0.27	0.29	1.3
Yams	0.28	0.35	3.4	12.74	14.29	1.7	3.60	5.02	5.6

Source: FAOStat.

The increase in arable land and permanent crop land in Ghana has been strong: during the last two decades (1990-2008), the area for arable cropping increased from 4.3 million ha to 7.2 million ha (see Figure 3.4), an annual growth rate of about 4 per cent (see Table 3.2). The increase has largely been at the expense of forest area and 'other land'. Forest area declined from 7.3 million ha in 1990 to 5.2 million in 2008.

Figure 3.4 **Land use changes in Ghana, 1990-2008 (in million ha)**

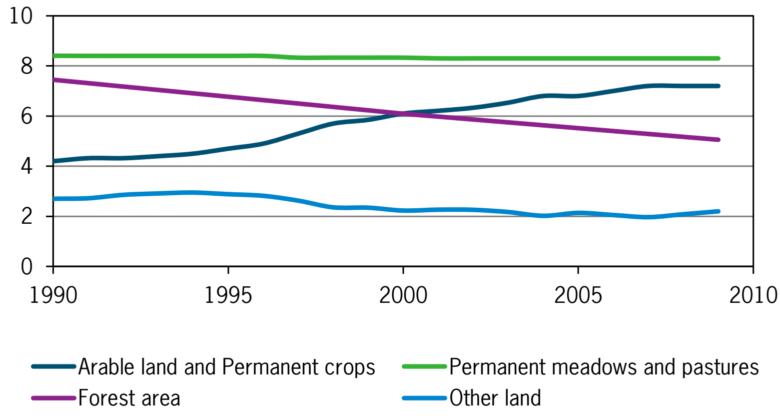


Table 3.2 **Ghana Land Use Change over 20 years (1990-2009)**

Ghana	Average acreage (M ha)	Average acreage (M ha)	Change rate (% y^{-1})
	1990-93	2007-08	
Arable land and permanent crops	4.28	7.20	4.01
Fallow land	-	-	-
Permanent meadows and pastures	8.40	8.30	-0.07
Forest area	7.31	5.17	-1.72
Other land	2.76	2.08	-1.44

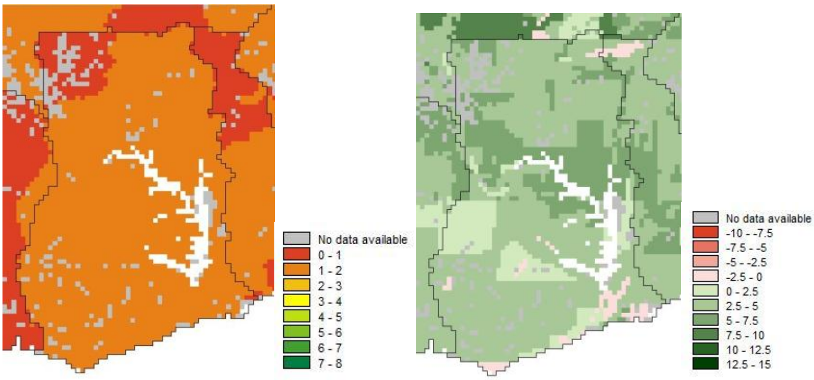
Source: FAO.

3.2.2 Productivity increase potentials

Like farmers in many countries in Africa, farmers in Ghana cannot take full advantage of the available natural resources that are available for crop growth and production. Based on temperature, precipitation rates, and soil types of the arable land, much higher productivity could be obtained.

As shown in Figure 3.5, values for the actual productivity for maize range between 0 and 2 t ha^{-1}; whereas rain-fed productivity potentials (i.e. with sufficient nutrients and without yield reduction due to pests and diseases) on arable land and permanent cropland may be 5.0 t ha^{-1} higher.

Figure 3.5 **Ghana actual yield (left) and yield gap map (t ha^{-1}), defined as the absolute difference between actual maize productivity, and potential productivity based on temperature, precipitation and soil type**



Source: Conijn et al. (2011b).

The main factors responsible for yield limitations are the lack of nutrients (soil fertility) and yield reductions by pests and diseases. The average fertiliser application rates for nitrogen (N), phosphorous (P_2O_5) and potassium (K_2O) increased in the years between 1997-2002 and 2004-07 (Table 3.), but the absolute application rates are still very low, compared to crop requirements for the growth conditions in Ghana. A maize crop that yields one tonne of grains per hectare contains 15, 3 and 3 kg of N, P and K, respectively. The absolute application rates hence indicate that soils are being depleted to sustain the current yield of 1-2 tonnes per ha. This phenomenon is common to most countries in sub-Saharan Africa. Note that fertiliser application rates are calculated as an average application on all arable land and permanent cropland (the area of which increased by 4 per cent annually in the period 1990-2010; Figure 3.4), and that it is more likely that higher amounts were applied on only a fraction of the arable land and permanent cropland, and that the remaining fraction of arable land and cropland did not receive any mineral fertiliser.

Table 3.3	Mean average fertiliser (N, P_2O_5 and K_2O) consumption, application and change rates on arable land (including permanent crops) over 1997-2002 and 2004-07 for Ghana					
Mineral fertiliser	**Average consumption (1,000 tonnes)**		**Change rate (% y^{-1})**	**Average application rate (kg ha^{-1})**		**Change rate (% y^{-1})**
	1997-2002	**2004-07**		**1997-2002**	**2004-07**	
N	9,895	16,518	11	1.67	2.38	7
P_2O_5	5,618	9,559	12	0.95	1.38	7
K_2O	5,462	25,593	61	0.92	3.68	50

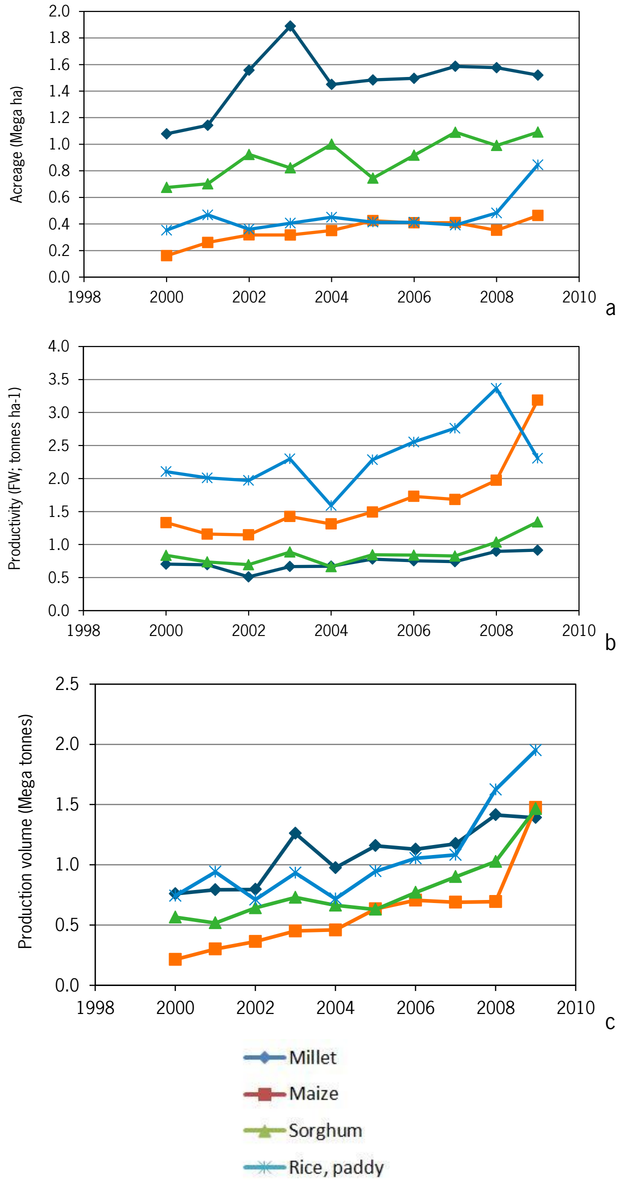
Source: FAOStat.

3.3 Mali

3.3.1 Crop production for major food commodities since 2000

The major food commodities in Mali are millet, maize, sorghum and rice. The development of harvested acreage, productivity and production volumes of these commodities is presented in Figure 3.6.

Figure 3.6 **Acreage (a; mega ha^{-1}), Productivity (b; fresh weight tonnes ha^{-1}) and Production volumes (c; fresh weight mega tonnes) of major food commodities in Mali**



Source: Source: FAOStat.

Both the increase in acreage under arable land and permanent cropland and productivity growth per hectare contributed to the growth of production of the major food commodities (Table 3.6). The harvested areas of major food commodities have increased more than the average 3 per cent growth of the area under arable cropping (Figure 3.6a). Productivity growth has been impressive, yet these growth rates are of recent years only and from a relatively low base level (Millet and sorghum, two commodities cultivated on the largest area, from around 0.6-0.7 tonne/ha, see Table 3.4). Consequently, the additional land use change was still necessary to feed the growing population in Mali (which has grown by 2.4 per cent per year since 2000; see Table 2.5). The increase in harvested area, together with the productivity increase rates, has resulted in production volumes that improved the food supply per capita, but has not led to a situation in which current production volumes are sufficient to feed the population.

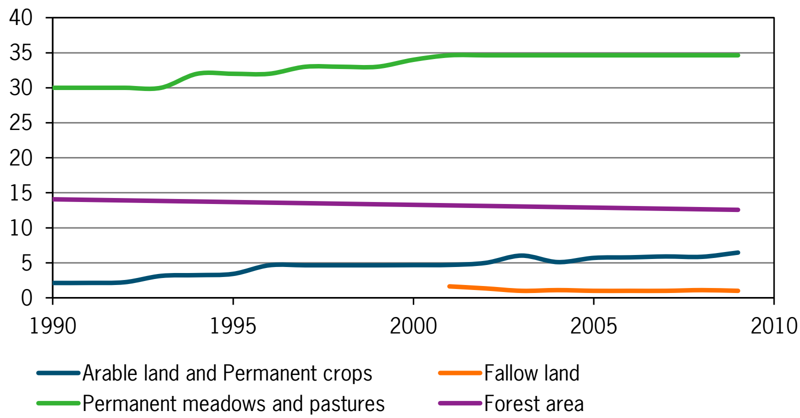
Table 3.4 Harvested area, productivity and production volumes for the major food commodities in Mali between 2000-02 and 2007-09

	Harvested area (mega ha)			Productivity (tonnes ha^{-1})			Production volume (mega tonnes)		
	2000-02	2007-09	(% y^{-1})	2000-02	2007-09	(% y^{-1})	2000-02	2007-09	(% y^{-1})
Millet	1.26	1.56	3.4	0.64	0.85	4.8	0.78	1.33	9.9
Maize	0.25	0.41	9.4	1.21	2.28	12.6	0.29	0.95	32.2
Sorghum	0.77	1.06	5.4	0.76	1.07	5.9	0.57	1.13	13.8
Rice	0.39	0.57	6.5	2.03	2.81	5.5	0.80	1.55	13.5

Source: FAOStat.

In Mali, permanent meadows and pastures are by far the main use of agricultural land. This area increased from 30 million ha to 35 million ha during the 1990s and has since remained constant (see Figure 3.7). The increase in arable land and permanent crop land was significant in the period 1990-2009: from 2.2 million ha to 6.1 million ha, an annual growth rate of about 10.6 per cent (see Table 3.5). The increase in agricultural land has largely been at the expense of 'other land' (not in Figure 3.7), which has shrunk by 7 million ha in the last two decades (see Table 3.5). Such 'other land' can be wetlands, savannah or other non-agricultural land. The definition of this category may be not be similar in all sources, not even within the FAO directorates; for instance, the FAO forest resources assessment (FAO, 2010) estimated that the area of savannah woodlands had halved since 1990 (from 16.5 million ha to 8.2 million ha), which is more than the 7 million mentioned above, which is based on FAOStat figures.

Figure 3.7 **Land use changes in Mali, 1990-2009 (million ha)**



Source: FAOStat.

Table 3.5 **Mali Land Use Change over 20 years, 1990-2009**

Mali	**Average acreage (M ha)**		**Average acreage (M ha)**	**Change rate (% y^{-1})**
	1990-93	**2001-03**	**2007-08**	
Arable land and permanent crops	2.16		6.08	10.64
Fallow land	-	1.33	1.03	-3.69
Permanent meadows and pastures	30.00		34.64	0.91
Forest area	13.99		12.65	-0.57
Other land	75.86		68.65	-0.56

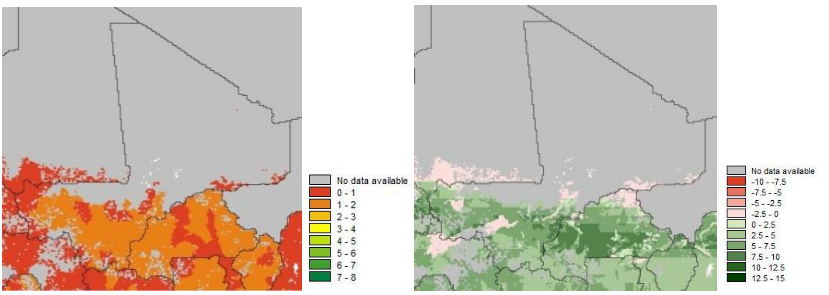
Source: FAOStat.

3.3.2 Productivity increase potentials

Like farmers in Ghana (and those in many other countries in Africa), farmers in Mali cannot take full advantage of the available natural resources that are available for crop growth and production. Based on temperature, precipitation rates, and soil types of the arable land, much higher productivity could be obtained.

As shown in Table 3.6 and in Figure 3.8, values for actual productivity for maize range between 0 and 2 t ha^{-1}; whereas rain-fed productivity potentials (i.e. with sufficient nutrients and without yield reduction due to pests and diseases) on arable land and permanent cropland may be 7.5 t ha^{-1} higher.

Figure 3.8 **Mali actual yield (left) and yield gap map (t ha^{-1}), defined as the absolute difference between actual maize productivity, and potential productivity based on temperature, precipitation and soil type**



Source: Conijn et al. (2011b).

The main factors responsible for yield limitations are the lack of nutrients (soil fertility) and yield reductions by pests and diseases. The average fertiliser application rate for nitrogen (N), phosphorous (P_2O_5) and potassium (K_2O) increased considerably in the years between 1997-2002 and 2003-07 (Table 3.), but the absolute application rates are very still low, compared to crop requirements under the circumstances in Mali. Note that fertiliser application rates are calculated as an average application on all arable land and permanent cropland (the area of which increased by 10.6 per cent annually during the period 1990-2009; Table 3.5), and that it is more likely that higher amounts were applied on only a fraction of the arable land and permanent cropland, and that the remaining fraction of arable land and cropland did not receive any mineral fertiliser.

Table 3.6	Mean average fertiliser (N, P_2O_5 and K_2O) consumption, application and change rates on arable land (including permanent crops) over 1997-2002 and 2004-07 for Mali					
Mineral fertiliser	**Average consumption (1,000 tonnes)**		**Change rate**	**Average application rate (kg ha^{-1})**		**Change rate**
	1997-2002	**2004-07**	**(% y^{-1})**	**1997-2002**	**2004-07**	**(% y^{-1})**
N	16,986	44,039	27	3.60	7.83	20
P_2O_5	14,245	32,731	22	3.02	5.82	15
K_2O	13,345	11,729	-2	2.83	2.09	-4
Source: FAOStat.						

3.4 Economic, technological and institutional bottlenecks to realising agricultural production potentials

Why are farmers unable to realise the agro-ecologically potential yields of their region?

The analysis in this chapter has shown that the present yields of major food commodity crops in both Mali and Ghana are far below their potential levels. These levels were estimated by assuming that the crop is being produced without the constraints that are normally found at the farm level, such as nutrient and water stress, inadequate cultivation practices, and so on. Adding nutrients, improving irrigation infrastructures and enhancing the adoption of accumulated knowledge would then be ways to reduce the yield gap. The difference between potential and observed yields could also be explained by economic constraints, because the optimal technical yield does not correspond with the yield that maximises profits or minimises costs. Here, the level of input prices is important, as these determine the technology (mixture of inputs) that is being used. In areas where actual yields are lower or much lower than potential yields, the recommended mixture of inputs to achieve the technical optimum does not reflect the relative input price relationship.

It has to be noted that yield or production per ha of land is only a partial measure of productivity. It does not take into account the use of other inputs such as capital, labour, fertiliser and irrigation. Under the assumption that inputs are substitutable, it is possible that the yield gap is not the result of inefficiencies, but is caused by producers' decisions to allocate resources so that profit (but not yields!) is maximised. For example, if in Ghana and Mali the rental price of land is low vis-à-vis the price of fertiliser, farmers will tend to adopt farming methods that require a relatively large area and limited fertiliser (this case is actually supported in some of the literature on African agriculture, which emphasises Africa's low population density and land abundance in comparison to Asia). This technology is efficient from both an economic and a technical perspective. Comparing the resulting yield with that generated on experimental stations under different management conditions and input prices will result in an observed yield gap. This, however, is a result not of inefficiency but of economic rational behaviour. Hence, the best case for the yield gap to be an adequate approximation of potential output is when the maximal yield is estimated using a similar input combination as the observed yield (see Nin-Pratt et al., 2011), Chapter 4, for a full explanation building on micro-economic theory).

In order to realise the high potential for agricultural yields in the two countries, the prices of the various inputs that are necessary to achieve that higher yield need to drop, or output prices need to increase so that more expensive but technically more efficient inputs could be allocated to the production process. A major bottleneck to improving yields in the two countries is that the necessary inputs are too expensive, while the limited size of markets hampers the prospect of more attractive output prices, which would induce farmers to invest in scale of production and/or yield increasing technology.

In Mali and Ghana there are enormous constraints on farmers as regards using technically more efficient inputs, as the costs of applying those inputs make the inputs inefficient from an economic perspective. With regard to mechanisation, for instance, the FAO (2010) conducted a survey indicating that although enough agricultural equipment is available in Mali, it is not accessible to many farmers. In Ghana, the interviewed stakeholders reported that agricultural equipment is hardly available.

A major constraint in both countries is therefore the poor access of farmers to mechanisation technologies. This is a result of the combination of the high cost of mechanisation inputs, the low purchasing power of the majority of farmers to acquire them and the poor access to loans by farmers (FAO, 2010). The difficulty of getting loans is a result of the poor functioning of credit markets. Data extracted from a Ghana Living Standards Survey indicate that of the 5000 rural households producing crops, only 8 per cent used credit for agricultural purposes (Krausiva and Banful, 2010). Looking into the sources of credit, borrowing from relatives and friends, followed by traders, is the most common way for households to obtain credit, as opposed to formal sources such as banks. The low agricultural credit figures indicate a lack of agricultural credit availability for rural households.

The same survey also reports about intermediate inputs employed in crop production like seeds, fertilisers and chemical inputs. The responses indicate that recycled seeds are typically used, and that only 19 per cent of the rural households purchased inorganic fertiliser, insecticide and herbicide. Ghana's government promotes the use of fertilisers through the voucher system it introduced in 2008, but the majority of these inputs are being purchased from private firms. A preliminary evaluation of the fertiliser subsidy programme reveals some of the difficulties of effective and well-balanced government interventions in this area (Banful, 2010). The government instituted a country-wide subsidy on fertilisers in the form of fertiliser and region-specific vouchers distributed by agricultural extension agents. Poor timing, a shortage of fertiliser and the limited number of fertiliser retailers participating in the programme prevented fertiliser use from increasing as much as was possible within the programme budget and may have disadvantaged smaller retailers.

Trade can also vigorously promote agricultural development, as it enlarges market opportunities, allowing economies of scale, specialisation and cheap/cheaper imports (e.g. FAO, 2008; UNCTAD, 2009). Access to markets that are larger than local markets can be complicated by many factors, such as policy interventions (e.g. tariffs, food safety requirements and other regulations), institutional bottlenecks (e.g. weak legal powers or lack of contract enforcement) and physical barriers (e.g. lack of infrastructure and transport vehicles). Sub-Saharan food markets are typically little integrated. Ghana, for example, is part of ECOWAS (Economic Community of West African States). Although the partners reduced regional tariffs, they are not much lower than world tariffs: at 12.4 per cent, the average tariff protection for regional trade remains relatively high (Van Dijk, 2011). This is mainly a result of high tariffs on dairy products, maize, rice and oil palm. Rather typical for African free trade arrangements is that although they are called free-trade agreements, partner countries maintain rather high tariffs on virtually all strategic food products, and hence protect their internal markets from (cheaper) imports. As a result farmers, traders and consumers do not gain from the benefits of trade.

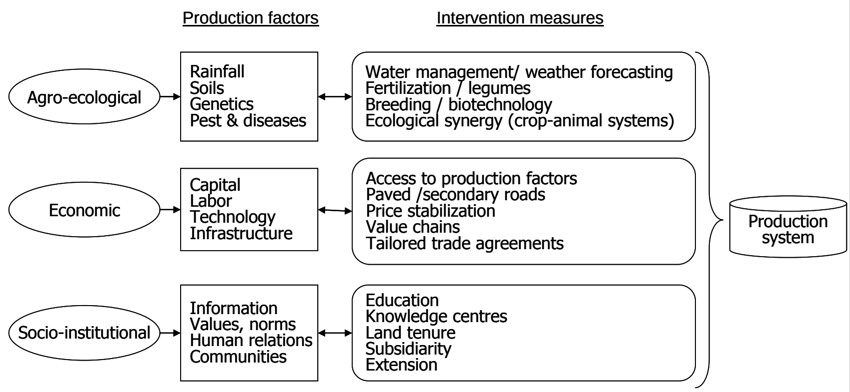
3.5 Conclusions

The efficient use of available precipitation (i.e. the establishment of efficient rain-fed agriculture) would reduce considerably the competing claims on land in Ghana and Mali. Weather is a significant factor for economic well-being in many countries in sub-Saharan Africa that depend on agriculture as a major livelihood.

Especially in areas with predominantly rain-fed agriculture, weather variability is a major determinant of economic growth (IBRD/WB, 2006). Under the threat of possible adverse weather conditions, poor farm households often choose low-risk, low-return activities and avoid costly innovations that could increase productivity (Ruben et al., 2006; Keating et al., 2010).

A number of intervention measures would lead to an increase in water use efficiency in rain-fed agriculture and thus reduce competing claims on land (Figure 3.9).

Figure 3.9 **Intervention measures to increase water use efficiency in rain-fed agriculture**



Source: Bindraban et al. (2009).

Financial institutions tend to restrict lending to farm households if adverse weather conditions might result in widespread defaults (Skees et al., 2006). The lack of access to credit restricts access to the agricultural inputs required to increase productivity and overall rural development. Hence, different risk coping strategies at different scales may be effective in reducing risk exposure in the short run, but may hinder growth and rural development in the long run (Conijn et al., 2011a).

4 Major bottlenecks to realising agricultural potentials in Ghana and Mali

4.1 Introduction

This and the following chapter focus on whether there are competing claims on land and water for food, feed, fuel and ecosystem services (forest, nature, ecologically vulnerable areas), and if so, what the driving factors of these claims are. Food security is at the centre of the analysis: what claims on land and/or water may conflict with maintaining or improving food security in Ghana and in Mali?

The following section concerns Ghana. The various competing claims that are relevant to food security are discussed. This is followed by a section on the drivers leading to these claims. The information was gathered from informants, experts and the literature.

4.2 Claims on resources competing with food security

The following competing claims are discussed in this section:
- Claims on agricultural land versus claims to maintain forest land for timber and other products/services
- Offshore oil drilling versus coastal and wetlands livelihood
- Small-scale versus large-scale domestic and foreign fisheries
- Mining activities polluting waters and taking land away from farmers
- International land acquisition.

4.2.1 Claims on agricultural land versus claims to maintain forest land for timber and other products/services

According to the FAO (2010), the forest cover of Ghana declined by 1.7 per cent per year in the period 1990-2010. Forests produce charcoal and timber to satisfy domestic and international demand. Deforestation may have positive consequences for food security, as more land for food production becomes available. However, the increase in deforestation leads to rivers being increasing loaded with sediments, while crests and ebbs in water supply could occur more frequently and be more extreme, which may have negative consequences for the water supply and the water quality in towns and villages downstream. The livelihood of people living near rivers may face more frequent flooding and inundations. When all the trees have been cut down and fuel wood is no longer available, local people who depend on fuel wood for their cooking will become less food secure.

Forests also serve as a source of bush meat. The local consumption and the export of bush meat generate a total of 300 million dollars for the Ghanaian economy every year (source: http://www.ghanaweb.com/GhanaHomePage/NewsArchive/articlephpID=171426). However, the production of bush meat is not sustainable: the animal stock used is declining rapidly and the poaching of forest products is a real problem.

Certain stakeholders are in favour of maintaining the forest cover: the wildlife department, the forestry commission and international donors that want to implement biodiversity policies. The forestry commission (a state agency) has to earn its own income, which is not an incentive for local authorities to promote the maintenance of forests.

Other international stakeholders are also in favour of maintaining forests. For example, the FLEGT process aims at legalising timber export to the European Union (see Appendix 1.3 in Arets et al., 2011). Several groups are competing for the dwindling forest resources:

- Competition between illegal chainsaw loggers versus established large-scale timber companies. If the existing laws were enforced, many people would lose their livelihoods, while the bigger companies would continue exploiting the forests.
- Competition between the international and the domestic demand for timber. National demand is increasing: as the Ghanaian economy grows, there is increased demand for construction materials. Continuing to supply both the national and international market at the present pace may lead to rapid deforestation.

The current legal and institutional situation is unfavourable for local people who use forests for their livelihood in a sustainable way. The common denominator seems to be that the claims from the international and the national level on land for maintaining and using forests have a detrimental effect on local livelihoods and the food security of local people.

However, there is also a positive example of forest management designed to support local livelihood and enhance food security. A recent development in Ghana is to revive the age-old *taungya* system, whereby land is cleared and initially planted with both food crops and tree seedlings (which, when grown, are harvested for timber). The taungya practice was reviewed by the government of Ghana and re-launched in 2002 as the Modified Taungya System (MTS). The new approach provides financial benefits for farmers and the other stakeholders, as the government has transferred ownership of the trees to multiple owners (farmers, local communities and government). MTS provides major services, including firewood and food crops, for both subsistence and commercial uses. Because of climate change, farmers migrate from the north and settle in the transition zone, where they find agricultural lands. Our source (Kalame, 2009) is not clear about how these lands were previously used: as savannah or as agricultural land by others? We assume that the state was and is the official land owner. Whatever the situation may have been, the MTS has improved the food and energy security of the migrants. Clearly understood tree ownership (clear agreement on who receives which benefits: state, farmers and local communities) and the integration of immediate livelihood concerns to ensure food and energy security are key to the short-term success of the MTS (Kalame, 2009).

4.2.2 Offshore oil drilling versus coastal and wetlands livelihood

Ghana recently became an oil producing country and started to exploit its offshore oil and gas reserves. Such activities may have negative impacts on the food security of people living in coastal and wetland areas (Clers, 2007) affecting:

- *Livelihood assets*
  Chronic pollution, gas flaring and the destruction of fish breeding grounds may negatively impact on the natural capital of local people. Because of the new oil activities, land tenure, property, rights of way and resource use rights may change to the disadvantage of local livelihoods. Rural livelihoods, particularly fisheries-based livelihoods, suffer from reduced access to capital with increasing poverty as result. Although this is often recognised by oil and gas operators, which include micro-financing programmes in their community outreach packages, local communities often lack financial management capacity. Monetary compensation funds therefore can easily evaporate.
- *Livelihood activities and strategies*
  Oil and gas projects interact directly with fishing operations, resulting in the loss of traditional fishing grounds, increased competition on remaining grounds, longer sailing routes, and an increased risk of collisions with shipping traffic and structures at sea. The expropriation of agricultural land

or dwellings may have a serious impact, and fishponds and fisheries in streams may be temporarily blocked.

Coastal and wetland livelihoods are very vulnerable to the negative impacts of oil and gas exploitation and exploration because of (Clers, 2007):

- Limited understanding by and recognition from key international and national actors of specific strengths, complexity and needs of coastal and wetlands livelihoods;
- Lack of recognised and legally binding tenure and resource use rights of coastal/riverine and submerged land;
- In general, large-scale 'mining' activities may have a negative impact on policies, institutions and social processes (the 'resource curse').

The issue of the impact of oil exploration on fisheries activities is rather new for Ghana, and major stakeholders only relatively recently informed themselves about it (CSRM and FES, 2009). The multi-donor NREG project (World Bank, 2011) facilitated the development of a draft strategic environmental assessment on oil and gas for consultation. The assessment outlines how environmental and social issues associated with developing the offshore oil and gas sector (worth about USD 1 billion per year over the next 20 years) should be mitigated or managed.

4.2.3 Small-scale fisheries versus large-scale domestic and foreign fisheries

There are currently disputes over jurisdiction, inadequate conservation and management measures, a large influx of foreign fishing vessels into Ghanaian fishery waters and a serious shortage of fisheries resources, all of which impact heavily on the country's ability to meet domestic demand, threatening fish food security, the livelihood of many Ghanaians and the country's economy.

Fish is consumed by all groups in society as a daily staple throughout Ghana. It is the country's most important source of animal protein: per capita fish consumption is estimated to be 25 kg, which is almost double the global average of 13 kg per capita. Illegal unreported and unregulated (IUU) activities lead to overexploitation, which ultimately results in reduction of the productivity and biodiversity of ecosystems as well as the ability of the exploited target species to recover. This implies a reduction in food security for the people who depend on fish as a major source of animal protein, hence creating a social problem, notably for the over 110,000 artisanal fishers and their dependants who live in the coastal communities (and depend for their diet directly on the fish that their family fishermen bring in).

IUU activities are carried out by both foreign and national vessels. There are many serious conflicts between fishers in all the three sectors of the fisheries industries in Ghana; that is, within and between the artisanal and the industrial, and between the two, the semi-local or local industrial sector. These conflicts are heightened by the activities of IUU fishing, because they undermine the income of the legal fishers (Kwadjosse, 2009).

The Draft National Fisheries and Aquaculture Policy 2008 provides a commendable framework for fisheries management in Ghana. Its content reflects an in-depth examination of the current state of the fisheries resources and a widespread consultation process in its formulation. However, more needs to be done in terms of consultation. It is critical to properly diagnose the problems. To successfully do this, it is essential to make a clear distinction between the symptoms or effects of the problems and the actual problem. This implies looking beneath the manifestations of the problem to find its causes (Kwadjosse, 2009).

4.2.4 Mining activities polluting waters and taking land away from farmers

On http://maps.worldbank.org/extractives/afr/ghana an overview is provided of industrial mining activities in Ghana. Most of these are gold related, with some mining of bauxite and manganese. It is estimated that in the last 20 years, hundreds of thousands of people in Ghana have been evicted from farms to make way for multinational mining interests. It is not clear whether there have been any effective compensation mechanisms (source: BBC message from 2006 http://news.bbc.co.uk/2/hi/programmes/file_on_4/5190588.stm accessed 04-10-2011).

In 2006, ActionAid produced a report on the impact of gold mining on poor people in Ghana (ActionAid, 2006). Its investigations highlight how rivers and streams are polluted with arsenic, iron, manganese and heavy metals from gold mining activities carried out by Anglo American's subsidiary, AngloGold Ashanti (AGA) and its predecessor, Ashanti Goldfields Corporation (AGC). Dozens of rivers previously used by thousands of villagers for drinking water, fishing and irrigation, are now reported to be unusable. Land in Obuasi area, previously used for cultivation, is believed to have been contaminated by gold mining activities and toxic water pollution.

For many years, environmentalists have been claiming that the cyanide used in mining operations degrades the soil. This allegation has been refuted by the government's Environmental Protection Agency, who claims that the mining companies have started complying with good environmental management practices (source: IPS message, 2008: http://ipsnews.net/news.asp?idnews=40999, accessed 04-10-2011).

A recent study highlights the role of illegal artisanal small-scale miners (*galamseyers*), who use mercury extensively in their activities. The mercury is a steady source of contamination of the surface water in the Tarkwa area (western Ghana). There is also cadmium-contaminated ground water. This source of contamination is largely anthropogenic. Effluents from extractive industries established over the last half century within the study area are directly discharged onto surrounding land and into surface water bodies. The discharge of effluents into surface and groundwater constitute non-point sources of contamination. Broadly, most of the water bodies in the study area have mean levels of arsenic, iron, mercury, zinc and lead that are above WHO and GEPA guideline values. High concentrations associated with high coefficients of variation therefore suggest anthropogenic sources for arsenic, iron, mercury, zinc and lead. This situation makes it imperative to establish an environmental monitoring scheme to check the concentration levels of heavy metals in the Tarkwa mining area of Ghana (Ato et al., 2010).

4.2.5 International land acquisition

Cotula et al. (2009) estimate that between 2004 and early 2009, 452,000 ha or 2.12 per cent of the land suitable for rain-fed crops was under investors' claim. Virtually all the contracts analysed by this study are strikingly short, and key issues like strengthening mechanisms to monitor or enforce compliance with investor commitments, through monitoring and sanctioning, maximising government revenues and clarifying their distribution, promoting business models that maximise local benefit, as well as balancing food security concerns in both home and host countries are dealt with by vague provisions, if any (Cotula et al., 2009).

Ghana is producing crops that potentially can serve as biodiesel: most of all palm nut, as well as soy bean, palm oil, coconut, jatropha oil and sunflower. Ghana also produces maize, cassava and cane sugar, which could serve as feedstock for ethanol. The government has set targets for the production of biofuels, but it needs to put in place very pragmatic measures if the intended targets are to be met (E. Antwi, 2010). Not everybody is happy with the targets the government has set. Multinationals and local companies in partnership with foreigners are reported to struggle for land, vigorously pursuing plans to cultivate the jatropha plant. Over 20 companies from various countries are acquiring land in Ghana to cultivate non-food crops and other crops for the production of ethanol and biodiesel, mostly for export. Ghanaian farmers are starting to realise what the agro-fuels boom implies for their livelihoods, and resistance is growing. Farmers in northern Ghana have rejected jatropha as an agro-fuel, mainly because they fear being tied down by fickle markets, and because of its toxicity, which limits its use (Daniel and Mittal, 2009).

The impact of biofuel production on one category of ecosystems, namely wetlands, has been estimated for Africa as follows (Sielhorst et al., 2008):

- Local food production can be displaced by production of biofuel crops if local farmers lose their land, either by selling it or having it expropriated, or if they switch to biofuel crop production themselves. This disrupts the local food market, necessitating imports and probably resulting in higher local food prices.
- Local food production can be affected by the decreased availability of water, which is already a limiting factor for agriculture in large parts of Africa.
- Food produced on community land can become less available if the land is used for biofuel crop production. In wetlands in particular, fisheries may be affected. Eutrophication, sedimentation and water drainage can lead to lower fish stocks. As fish is a major part of many wetland communities' diet, the impact of this consequence can be considerable.

By pointing at the direct effects of biofuel production at the location of production (such as erosion, water use and employment) and such indirect effects as increased food prices (due to increased demand for agricultural produce) and the increased conversion of natural areas (due to increased land pressure), Sielhorst et al. (2008) conclude that food security for communities in wetland areas may be jeopardised as a result of biofuel production. However, there might be positive effects, too, such as higher production and/or gross margins per hectare for farmers, locally produced energy that is locally available and used, et cetera. So far, little research has been performed on this topic; however, such research is necessary in order to gain insights into the local and regional impacts of large-scale biofuel production in, for instance, wetlands in Ghana.

4.3 Drivers

What are the drivers of the various claims?

- The population is growing and more land (and other resources like fish) is needed to earn a living and feed the population. Farmers want to use land covered with forests for agricultural crops.
- The land tenure system in Ghana is very complicated and lacks clarity. According to law, benefits of trees and forests go first of all to the state. For example, trees on private farm land belong to the state. This promotes a situation with few trees on farms, for example on cocoa farms (Ruf, 2011). The land tenure situation is undermining a more profitable use of forests by local communities (e.g. in arrangements between state and communities) for collaborative forest management, and thus encourages the conversion of forest land into agricultural land. A positive development is the re-launch of the taungya system as the Modified Taungya System, whereby ownership of trees is shared by various stakeholders. Despite the progress made, Ghana's collaborative forest management efforts should focus more on tenure reforms that address community-controlled forestry and improve local governance, especially concerning accountable representation and equitable benefit sharing (Marfo, 2009).
- There is a strong international demand for timber. The FLEGT process initiated by the EU, promotes the certification of timber production. Law enforcement, however, may lead to a situation in which local populations are deprived of their main sources of income (their activities are officially illegal, as they do not comply with the law). See for much more discussion on this issue the website http://www.vpa-livelihoods.org/homepage.aspx, which is managed by a project with the title: 'Illegal or incompatible?'
- The offshore gas exploitation is driven by the high international demand for gas as a source of relatively clean energy. The exploitation has clear benefits for international stakeholders like drilling companies and for the national government (increased revenues). The pressure comes from their side to exploit the resources. The benefits for local dwellers are less conspicuous. Compensation payments for lost opportunities, et cetera will only be beneficial for local coastal and riverine dwellers under certain conditions, which have to do with, for example, local governance, tenure rights (which is a part of national governance aspects) and the capacities of local dwellers to organise themselves in an effective way (Clers, 2007).
- Key drivers for international government-backed investment in land acquisition are food security concerns, particularly in investor countries. But many

government-backed deals are driven by investment opportunities rather than food security concerns (e.g. China). Related drivers behind current land deals in Africa are the global demand for non-food agricultural commodities and biofuels, expectations of rising rates of return in agriculture and land values, and policy measures in home and host countries (Cotula et al., 2009). The rush for land to produce biofuels is promoted by, for example, the EU target of 10 per cent substitution of diesel and petrol with biodiesel and ethanol.

4.4 Conclusions derived from the Ghana case

We identified five competing claims on land: claims on agricultural land versus claims to maintain forest land for timber and other products/services; offshore oil drilling versus coastal and wetlands livelihood; small-scale versus large-scale domestic and foreign fisheries; mining activities polluting waters and taking away land from farmers; and international land acquisition.

The claim on forest land for timber production and conservation seems to be losing ground. Deforestation goes on, and it is the forest that needs more protection to maintain certain vital ecological services. The forest is currently still a valuable source of protein in the form of bush meat. That source will most probably dwindle and so there is a need to replace it with other sources of protein.

The offshore oil drilling could be a threat to coastal and wetland livelihoods. As far as we know, there are no hard figures showing that it is a big threat to food security right now. Oil drilling is a recent phenomenon and its impacts on local livelihoods and food security need proper monitoring.

The competing claims between small-scale and large-scale domestic and foreign fisheries is serious. There are some 110,000 artisanal fishers whose livelihoods will be at stake when more of the fisheries resource is taken away by large-scale fisheries vessels. From the perspective of food security, this issue needs more attention.

The competing claims between mining activities and food security are illustrated here with some local studies. We could not find an assessment of the overall situation in the country. But at least at the local scale, mining activities are polluting waters and agricultural land, threatening the food security of local people.

The competing claims between the food security of Ghanaian people and international land investment are real. Already in 2009, more than 2 per cent of all rain-fed agricultural land was under investors' claim. Under normal circumstances, 2 per cent does not seem very much, but in times of international scarcity, this difference may lead to a sharp increase in food prices. Does that imply that investments in land (e.g. for biofuel production) is bad under any circumstances ? In the Netherlands a multi-stakeholder group produced criteria for the sustainable production of biomass (Kramer, J. et al., 2007). Such criteria are generic and not focused on specific situation in countries. There is still much debate on this issue. The least we can say is that, when considering biomass production on a large scale or an international land acquisition, it is important to take into account food security and local livelihood issues, including differences in power between different actors.

Behind many of these issues is a need to improve the governance of land and natural resources, guaranteeing the better participation of local stakeholders in decision making and benefit sharing. Land and resource tenure is an issue that returns time and time again. It is important for food security to come up with fair and transparent solutions that are beneficial for local livelihoods.

5 Competing claims and food security in Mali

5.1 Claims on resources competing with food security in Mali

This chapter answers the question what claims on land and/or water may conflict with maintaining or improving food security in Mali. In this section the following competing claims are discussed:

1. Large-scale irrigated agriculture versus local livelihoods, including the use of water upstream or downstream;
2. Claims on land and water for agriculture versus biodiversity conservation;
3. National/international investments in land versus local use;
4. Conflicts over land use between herders and farmers.

5.1.1 Large-scale irrigated agriculture versus local livelihoods

A clear competing claim in Mali is based on the intensive use of water for extensive irrigation upstream from the inner delta, a large wetland area in central Mali. Besides being an important ecological system supporting biodiversity, including species protected in Western Europe (see Section 5.1.3), it supports many natural resources that are important to local livelihoods

Office du Niger is the most important agricultural production area in Mali (Verburg et al., 2009). It is a large-scale irrigated agricultural scheme in the western part of the Inner Delta (Le Delta Intérieur), where rice production used to be the most important production system only during the rainy season. Since the rehabilitation of the irrigation infrastructure, however, the production of rice is also encouraged during the dry season. The system uses a lot of water, which is only possible through an irrigation network of dams and canals, which reduces water availability downstream in the Inner Delta.

The highly productive vegetation in the Inner Delta is a vital link in the flood plain ecosystem. For example, the floating bourgou fields are indispensable as a nursery habitat for juvenile fish, providing both protection and food. The economic significance of these bourgou fields to the fisheries and agricultural sectors is substantial, and as the flood retreats it provides food for the omnipresent livestock. Nearly one million people earn their livelihoods in the Inner Delta as fishermen, cattle breeders or farmers. They depend entirely on the natural resources found within an area of 50,000 km^2 (Zwarts et al., 2005). The annual production of fish, cattle and rice in the Inner Delta is determined by river discharge and is insufficient to feed local people in drier years, which is why many people have abandoned the drier parts of the Inner Delta over the past 40 years. Further migration can be expected if additional water is diverted upstream. The shift towards large-scale irrigation also means a shift from the traditional staple foods (beans and millet) towards agricultural land for rice and cotton/sugar cane. Rice was originally not the staple food for local populations.

The construction of new dams (see Box 5.1) is likely to cause transfers of benefits from the Inner Delta to the upstream Upper Niger region. Improving the performance of the existing infrastructure as well as the economic activities in the Inner Delta itself, is a significantly more efficient way to increase economic growth, reduce poverty and protect the environment in the region than the building of a new hydropower plant (Zwarts et al., 2005). The irrigation schemes and dams in the Upper Niger Basin are meant to enhance prosperity in Mali or, more specifically, to achieve food security. However, for the people living downstream, the consequence is that food security will not increase but decline. There is a need for an effective water management plan for the entire basin, taking into account climate change (Zwarts, 2010).

5.1.2 Claims on agricultural land and water can result in the loss of natural resources and biodiversity

As mentioned, the Inner Delta is not only an important source of natural resources on which many people depend, but is also renowned for its high biological value, both nationally and internationally (as a RAMSAR site). The bourgou fields act as a key habitat for a number of fish-eating bird species (Zwarts et al., 2005). As a result, it hosts a high concentrations of water birds, and large fauna, like ungulates (hoofed animals), reptiles and hippos (Wymenga et al., 2002). Flood forests form a unique habitat in the Inner Delta. Few tree species can survive prolonged inundations, alternated with months of drought. Thus, flood forests are extremely poor in tree species, and some forests comprise only one species: *Acacia kirkii.*

However, the same forests are very rich in nesting colonial water birds, sometimes hosting tens of thousands of as many as sixteen species (Beintema et al., 2007). The Inner Delta is an important wintering habitat for millions of migratory birds from Eurasia. Bird species that are protected in Europe and the Netherlands depend on this wetland area for their survival (Zwarts et al., 2009). The Dutch government has funded both research and the nature management/

sustainable development of this part of Mali, while Dutch development funds have supported the further development of the intensive irrigation schemes in Office du Niger. Increasing crop productivity in the dry land areas could offer a sustainable way to reduce the claim on water that is vital to the agricultural production of the whole of Mali, the local livelihoods of farmers and fishermen in the delta, while at the same time reducing the pressures on the important habitat services the delta provides for international biodiversity.

Yet, the hydro dams and irrigation schemes upstream (see Box 5.1) greatly reduce the water availability of the wetland ecosystem, disrupting its natural functioning, its dynamics and its biodiversity function.

Box 5.1	**Hydro infrastructures and irrigation schemes**
There are three large hydro infrastructures in the upper Niger, and three more are being considered. These reservoirs have an impact on the river flow and, consequently on the flooding of the Inner Delta. Since the amount of water consumed hardly differs between dry and wet years, the relative impact of these reservoirs on the river flow becomes more pronounced in years with poor flooding. The artificially created lakes result in the loss of water due to evaporation and loss to the groundwater (Zwarts, L., 2010). A good example is the Sélingué Dam, a single-purpose hydroelectric dam located in Koulikoro Region, on the Sankarani River, one of the affluents of the Niger River. It is Mali's second most important centre of energy production (source: Wikipedia). Below the hydro dams, irrigation schemes are present, for example the Sélingué hydro dam, while in other places dams in the river system are constructed to feed irrigation systems. The combined impact of the existing and the planned infrastructure is that the flow of the rivers at the entrance of the Inner Delta will decline, leading to less inundation and, consequently, a loss of economic and ecological functions. Especially the September peak flow will be affected. The flood extent of the Inner Delta has already been reduced by 13% in a dry year due to the Sélingué dam and irrigation by Office du Niger. Since the irrigated area of Office du Niger will be expanded in the future, this loss will increase to 20% or even 27% at a maximal extension. If also the Djenné and Fomi dams are constructed, 56% of the flooded area will be lost in total. Irrigation schemes and reservoirs are constructed such that even in years with a low river flow, the same amount of water can be taken. Hence, if the river flow declines by 20-40% due to global climate change, the combined effect of climate change and all infrastructures will be that more than 70% of the floodplains will be lost (Zwarts, L., 2010). Water will become a huge problem in the future (Van Vugt et al., 2011).	

5.1.3 International land investment

By the end of 2010, at least 544,567 ha of fertile land in Mali had been leased or was under negotiation for lease. This figure increases to 819,567 ha if one takes into account unofficial expansion plans. An example of large-scale land acquisition is the Malibiya project (see Box 5.2). More than 40% of all land deals involve crops for agro-fuels. Most of the large agricultural projects are still in their early stages; the projects have not yet become fully operational (Baxter and Mousseau, 2011). In November 2010, farmers' associations and civil society groups held the 'Kolongotomo Farmers' Forum on Land Grab in Mali' (see http://farmlandgrab.org/17414, accessed 20-10-2011) and produced a list of issues confronting smallholders in Mali as a result of the government's desire to lease large tracts of fertile land. In Office du Niger, several major problems characterise the land acquisition trend in Mali, for example:

- The land rights of local communities have been ignored during recent land deals.
- A lack of transparency and disclosure of land deals.
- The 'availability' of land to investors is problematic in a country that is plagued by hunger and is under threat of increased desertification

These types of problems are also present elsewhere. For example, in the American ‘Alatona’ programme (in the north of Office du Niger), people are encouraged to grow rice. Each farmer/livestock owner receives 5 ha on which to grow rice. This, however, encourages speculation, as it is virtually certain that these people will sell their land quickly and return to their traditional livestock breeding (Van Vugt, personal comment, 2011).

Box 5.2	International land acquisition: Malibiya
The Malibya project is a recent example of international land acquisition. According to a Yale report issued in February 2011, Mali and Libya have begun a major agricultural project that will divert much of the river's water (http://forum.prisonplanet.com/index.php?topic =204239.0). Environmentalists are beginning to concentrate their attention on the Malibya project. Established in 2008 by then Libyan Africa Investment Portfolio, which answers to the Libyan Investment Authority, with the agreement of Mali president Amani Toumani Toure, the Malibya programme is due to farm at least 100,000 ha in Mali's Segou region to grow rice and thus reduce Libya's dependence on exports (source: http://www.africaintelligence.com/ MCE/business-circles/2011/02/10/malibya-farm-project-under-fire%2C88005150-ART-login). It is unclear whether this project will continue in light of the Libyan revolution in 2011. It was still in full swing June 2011.	

5.1.4 Conflicts between herders and farmers

There have always been conflicts in Mali between herders and farmers, but the situation is now different. The most striking change in the relation between farmers and herders is the disappearance of socio-professional specialisation, which has led to overlapping and more heterogeneous interests. The activities of different user groups are now even more conflicting and competing. The most obvious example is manure and the relationships of exchange: while it was once understood that herders stayed in the fields during the dry season to manure them and exchange grain, milk and meat with farmers, this is no longer necessary. The sedentary farmers have their own livestock, and many herders have their own fields. Moreover, cow dung is no longer entirely suited to the current climatic conditions, as it will burn the crops if there is not enough rain. This has led to growing pressure on natural resources, a marked deterioration in relations between farmers and herders, and to both latent and open conflicts. This is a very serious situation, because it is based on ethnicity and has the potential for serious escalation. Dialogue and conflict management are needed (Beeler, 2006), and especially the causes should be looked into.

5.2 Drivers

What are the drivers of the various claims?

1. The first case of competing claims was between agriculture and biodiversity conservation. The desire to conserve biodiversity is an international driver, for example institutionalised in the Convention on Biological Diversity (CBD). Mali is signatory to the CBD, the Convention on the Conservation of Migratory Species of Wild Animals (the 'Bonn Convention') and the Ramsar Convention, and promotes a community natural resource management approach (Zwarts et al., 1999). A concrete actor in the conservation of biodiversity in Mali is the government of the Netherlands, which for example supported research on the value of biological diversity and ecosystems in Mali. This led to the development of an instrument for early warning as to water levels and for spatial planning (Zwarts, 2009).
2. The second case of competing claims is between large-scale irrigated agriculture and local livelihoods. On the one hand there are the local inhabitants, who also want economic growth (rice in combination with vegetables), while on the other hand there is the government, which wants economic growth and investments and additional income. So the driver is the quest for additional income and/or foreign exchange (the rice is used for export; Van Vugt, personal comment)
3. The next set of competing claims are international investments in land versus local use. At the national level, the driver is the quest for a certain type of development and additional income for the government and private sector. At the international level, the driver is the quest for food security of the country that makes the investment (like Libya) or the quest for biofuels (which is a - debatable - answer to international climate mitigation needs). A driver is the international market force: the demand for cotton and rice, which makes the establishment of new irrigation projects attractive. Perhaps even more important, international investment in land is related to interdependence between states and institutional settings.
4. The competing claims between herders and farmers concerning the use of land seem at first glance to be a national issue. The conflict has existed for a long time, but the situation seems to be deteriorating. It does not appear to have an international component; at least, there is no concrete international actor involved. However, there is a connection with climate change, an international phenomenon, driven by countries that produce greenhouse gases. A driver is the changing practices of herders and sedentary farmers: both groups seem to engage in both agriculture and cattle breeding.

The positive role of manure provided by herders to sedentary farmers now seems less obvious, as climate change has resulted in less rainfall. But this also strongly related to coping mechanisms: both herders and farmers are resilient to the changes around them and try their best to cope, which they do by diversifying.

5.3 Conclusions derived from the Mali case

Four types of competing claims have been identified: (1) claims on land and water for agriculture versus biodiversity conservation, (2) large-scale irrigated agriculture versus local livelihoods, including the use of water upstream or downstream, (3) national/international investments in land versus local use, and (4) conflicts over land use between herders and farmers. Drivers include: (a) concerns about the conservation of biodiversity (including the need to protect the flyways of migratory birds), (b) the governments' quest for additional income, including foreign exchange, (c) foreign countries' quest for food security and biofuels, (d) interdependence between states, and (e) climate change and the need to diversify farmers' activities.

It is clear that these competing claims can significantly jeopardise efforts to improve the food security of the inhabitants of Mali. How can such claims be effectively dealt with? Principles include:

- Respect the land rights of local communities.
- Prioritise the food security of the inhabitants of Mali over profits for specific national and international stakeholders.
- Address gender and diversity issues.
- Choices have to be made for which groups and for what commodities. Competing claims can only to a limited extent be solved by creating win-win situations (e.g. more productivity).

Approaches include:

- Dialogue between and conflict management for various stakeholders.
- Promotion of transparency and disclosure of land deals.
- Participatory land and water use management.
- Sustainable management of natural resources in close cooperation with local inhabitants.
- Improvement of existing farming systems and improved productivity of soils.

- Improving the governance of natural resources at various administrative levels, including existing traditional authorities.
- The starting point is to understand the food and nutrition security situation at a country level. Who is food insecure, in what numbers, in what locations and for what reasons? What likely impacts could resource degradation, climate change, markets, conflict or political instability have on this situation in the future?

Such approaches are not simple activities that can be executed in a one-off way. They are persistent problems and need planning and a strategy. The issues at stake are all related to power imbalances and relations. This demands a long-term integrated multi-stakeholder approach.

Our analysis stresses the importance of natural resource management, resilience to climate change, gender and governance/institutional setting. Specific interventions are needed to deal with these crosscutting issues. They are necessary in order to deal effectively with the competing claims in the area.

6 Major findings and recommendations to address competing claims on land and water in Ghana and Mali

6.1 Major findings

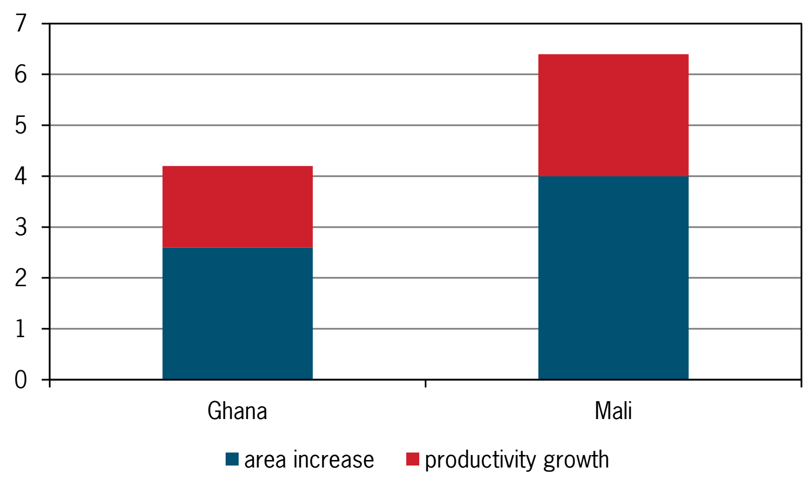
Rapid economic growth and development in Ghana since 1990 has resulted in an improvement in food security, as the proportion of the undernourished population decreased from 27 per cent in 1990-92 to 5 per cent (1.2 million) in 2005-07. Although the intensity of food deprivation has decreased to a 'low' figure of 180 kcal per person per day, it is still insufficient for a healthy diet. The country has a large deficit in rice and wheat, but for all other major food crops supply exceeds demand. Overall food supply at the national level is improving, yet some regions (such as in Northern, Upper East and Upper West) face serious food insecurity and undernourishment.

Undernourishment in Mali dropped from 27 per cent of the population in 1990-92 to 12 per cent (1.5 million) of the population in 2005-7. Although the intensity of food deprivation also dropped to 220 kcal per day, it is above the 200 'low' threshold defined by the FAO. Mali is nearly self-sufficient in the production of some of the major food crops; for millet and sorghum, total domestic production slightly exceeds total consumption, while there was a surplus of rice in 2005-07. With regard to maize and sugar, demand is larger than production, resulting in the import of these commodities along with wheat and dairy products.

The indicator of the overall food production development is the per person food production index. For Ghana, this index increased by 1.9 per cent over the period 2000-07, and by 4 per cent in Mali over the same period. With an average population growth of respectively 2.3 per cent and 2.4 per cent in Ghana and Mali, the increase in the per person food production index suggests that the overall food production (volume) grew by 4.2 per cent and 6.4 per cent, respectively, between 2000 and 2007.

The growth in food production in Ghana and Mali has been achieved by a combination of increasing production per hectare and an increased agricultural area. The following figures make clear that the increase in areas has contributed by far the most (namely two thirds) to the increase in food production in both countries (see also Figure 6.1). In Ghana, the increase in agricultural land (from 6.1 to 7.0 M ha, i.e. an increase of 2.6 per cent per year between 2000 and 2007) has largely been at the cost of deforestation (see section 3.2). In Mali, agricultural land increased (from 4.7 to 5.8 M ha, i.e. 4.0 per cent per year between 2000 and 2007). In the Office du Niger region, large-scale irrigation schemes were developed at the expense of other land (wetlands, savannah, non-agricultural and/or fallow land), thereby reducing the inundation of downstream wetlands. There is a clear trade-off between increased food production and ecosystem degradation, namely loss of biodiversity in both countries, while in Ghana livelihood activities in forests and in Mali wetlands downstream from irrigation dams are threatened.

Figure 6.1 **Production growth and the contribution of area increase and productivity growth to it in Ghana and Mali**



Source: Own calculations, based on FAO data.

If, as expected, population growth continues to exceed agricultural productivity growth in the coming years, both countries will need to continue expanding their agricultural areas in order to feed their populations. This will further increase the identified competing claims on available land at the expense of natural ecosystems and the local people who depend on these resources for their livelihood. Another option is to import food. Ghana has natural resources to export (oil, metals, et cetera), but Mali is poor in such resources. An alternative way to reduce competing claims on land is to further increase production per hectare.

It is often assumed that water availability is the most important limiting factor for plant production in the rain-fed agriculture in West Africa. The results of Chapter 3, however, show that plant production is still more limited by a lack of nutrients: there is still much room to improve yields by applying fertiliser without the need for more water than can be obtained from rainfall. Already in 1983, Breman and de Wit (1983) showed that in areas receiving more than 300 mm rain per year, nutrient availability limits plant biomass production. These insights have been supported by many other studies (e.g. Aune and Bationo, 2008; Lobell et al., 2009).

However, yield improvements are not likely to be achieved easily. Mainly because of the high variability in rainfall and the diversity in soil characteristics, production may vary greatly over the years and farmers become highly uncertain whether they will earn back the investments in improved soil and water improvement technology and fertilisers. These management strategies have therefore not yet been implemented on a large scale, even though there have been several programmes to promote the use of fertilisers. The main underlying causes are related to uncertain land tenure, poor market access and climate variability resulting in uncertain yields. In many cases, also poor access to loans prevent the necessary investments in using more and higher quality (and hence, more expensive) inputs (seeds, fertilisers, et cetera).

6.2 Recommendations

Reducing farmers' uncertainties about whether productivity improving investments will be profitable, may be an important response to the problem of reducing competing claims on land and water between different groups and regions and alleviating pressure on natural ecosystems.

An incremental approach as proposed by Aune and Bationo (2008) could gradually improve the productivity in rain-fed systems without the need for farmers to make several large investments at the same time. Aune and Bationo showed that relatively simple measures - like the better use of organic fertiliser, water harvesting, and the priming of seeds and pre-germination - could improve yields substantially at no additional costs to the farmers. Next to improving nutrient availability in the soil, the use of organic fertiliser also improves soil characteristics by improving the soil’s water holding capacity. Seed priming, namely soaking seeds in water for eight hours, has been shown to increase the yields of millet and sorghum in Mali by 50% (Aune and Bationo, 2008). In a next step, farmers could start applying small amounts of mineral fertiliser to improve the early growth and the survival rate of plants. This combined with seed priming has resulted in a doubling of millet production in Mali.

The livestock component of the farming system can be strengthened by increasing the use of cowpea - an important legume that can improve both nutrient availability and fodder quality. More advanced farmers could also introduce agro-forestry systems with trees that provide shade for improved production under high temperatures and provide fodder for livestock. Some of the proposed measures require only increased labour inputs, but the more advanced improvements also require access to credit and institutional support, resulting in higher uncertainties and risks for the farmers.

There are many other market-based or government-run options to reduce farmers' uncertainty about prices and income. For example, Beekman and Meijerink (2010) point at various risk management tools that are being used in sub-Saharan Africa. Market-based instruments that reduce the risks linked to price variability are warehouse receipt systems, futures and options contracts that can be traded in commodity exchange markets. Other instruments are farmers' cooperatives and contract farming mechanisms, which are widely applied in many countries in sub-Saharan Africa. Income stabilising market instruments include forward and pooling contracts, insurances and index-based products such as weather insurances, and credit and micro-finance provision. Government policies aimed at reducing price variability (price stabilisation policies, taxes, subsidies) and income variability (safety nets) are also applied in many countries. To apply risk management instruments, though, requires market infrastructure and institutions (some instruments are more demanding than others). In addition, farmers should also be supported to deal with risk and uncertainty. Apart from investments in market, investments in human capital are of central importance (extension, education, capacity building).

With climate change projections for the Sahel and West African regions showing a robust increase in surface temperatures and uncertain projections for precipitation (e.g. Roudier et al., 2011; Schlenker and Lobell, 2010; Solomon et al., 2007), drought incidence and severity in both countries is very likely to increase in the future. This will further increase uncertainty for farmers. In arid regions, afforestation schemes or preventing the loss of trees may substantially improve local climate conditions and reduce climate variability. On a more micro scale, shade trees will provide cooling for crops and improve the water retention capacity of soils, while their litter may provide fodder for livestock; some tree species are also suitable to provide fuel wood sustainably. However, since trees may also increase evapotranspiration locally, local conditions need to be assessed carefully before large-scale afforestation is implemented.

Controlling variability through agronomic measures may also reduce risk drastically. Proper soil and water conservation measures that would allow storage of an additional 50-100 mm in soils through the prevention of rainwater run-off, would suffice to carry a crop through a drought period of two to three weeks. Early warning systems and advanced weather forecasts may help farmers to optimise their practices, such as planting or fertiliser application when rainfall probabilities are high. Improved insight into the spatial distribution of soil characteristics allows the better targeting of the quality and quantity of fertilisers, and when and how frequently they are applied. Assessment of disease outbreaks and their dispersal can help farmers to take timely plant protective measures. Seed priming in combination with micro-fertilisation improves root development, making plants more drought resistant, which may reduce uncertainty about drought events.

A more systemic reduction of risk is key to further agricultural development with the efficient use of scarce natural resources, such as nutrients, water and fertile land. For this, investments in economic and agro-technical infrastructure and services are necessary, which donors like the Dutch government can help to realise in countries like Ghana and Mali. Yield improving investments through skills improvement, knowledge enhancement, and the use of better inputs, equipment and ICT services may offer many opportunities to Dutch agro-related businesses and knowledge providers.

Supplementary solutions may also lie in a better appreciation of services provided by natural or semi-natural ecosystems as an instrument for reducing vulnerability to climate variability and climate change. The impact, in time and space, on food security of losing these services (local climate regulation, erosion control, water regulation) needs to be taken into consideration when planning the expansion of arable land and irrigation schemes (e.g. Bouma et al., 2010). If farmers also can generate income from forest/wetland related services, this can compensate for low crop yields. An important scheme for payment for ecosystem services that is currently being developed within the UNFCCC focuses on reducing carbon emissions from deforestation and forest degradation. The idea behind the scheme is that developing countries can be compensated for maintaining forests (e.g. for not converting forest land into arable land). Such payments could be used to increase production on existing arable land without having to expand into forest areas. The current implement-tation of the FLEGT initiative in Ghana, however, shows that in order to be successful, the interests and livelihood strategies of local stakeholders need to be explicitly addressed.

The examples in Chapter 5 show the position of various groups in society that are affected by the increasing claims on land and water in Ghana and Mali. Whatever solution or policy intervention is used to address competing claims on natural resources, there will always be conflicting interests among the stakeholders. The key to reducing these conflicts is to promote dialogue with the various stakeholders in order to bring forward possible solutions to reduce trade-offs between claims on natural resources. This calls for a strategy and an operational plan to improve sustainable food production in countries like Ghana and Mali where serious competing claims on natural resources have been identified.

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