

Agriculture, Ecology, Globalisation and Postcolonial Structures: The Cases of Ghana and Benin



8th International Study Tour to West Africa
from 5th to 20th March 2023

Report

Organised by

Organic Plant Production & Agroecosystems Research in the Tropics & Subtropics University of Kassel / Witzenhausen

Animal Husbandry in the Tropics & Subtropics (Universities Kassel and Göttingen)

German Institute for Tropical and Subtropical Agriculture – DITSL GmbH Witzenhausen

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All pictures in this reader are taken by excursion participants unless stated otherwise.

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PREFACE

The University of Kassel at its campus Witzenhausen and the University of Göttingen offer study programs in the fields of agriculture, forestry, environmental and natural resource management, food, nutrition and related sciences in the context of rural development, sustainable resource use and poverty alleviation with a regional focus on developing countries, especially in the tropics and subtropics.

Both universities have a wealth of expertise in the study of tropical land use systems and the promotion of sustainable natural resources management. Many of the students interested in these topics will eventually conduct research in subtropical and tropical countries, often as part of their MSc or PhD thesis. Their academic curriculum must prepare them for this task. It is obvious that even the best lecture at a university in a so-called "developed" and temperate region cannot replace the experience gained during a visit to a tropical country. Therefore, student excursions to tropical countries are a highly desirable part of such a curriculum.

Scientists from the agricultural faculties of both universities are engaged in mutual research, academic training and networking activities with the University for Development Studies in Tamale, Ghana, and the University of Parakou in northern Benin, in particular within the framework of the BMBF-funded project DecLaRe "Decision support for strengthening land resilience in the face of global challenges". The student excursion in March 2023, entitled "Agriculture, Ecology, Globalization and Postcolonial Structures: The Cases of Ghana and Benin" with 23 students and 2 lecturers from Göttingen and Witzenhausen has benefited from these institutional and personal connections.

From an agricultural and forestry perspective, but also in view of their colonial history, Ghana and Benin are ideal countries for a scientific excursion focusing on the impact of post-/colonialism and globalization on agricultural production and value chains, such as cocoa and palm oil. Both countries are characterized by similar agro-ecological zones, ranging from the humid coastal area of West Africa to the dry belt of the northern Sudanian savannah. The diversity of the agricultural and forestry sectors in both countries, ranging from transhumant pastoralism to the production of export commodities such as chocolate, allows for the study and discussion of alternative development pathways within the sector as shaped by the colonial history and policies of the British and French, and the international networks of today's modern states.

Raising funds for such a trip is difficult, and we are grateful for the generous financial support of

University of Kassel through the SHOSTA grant program

Faculty of Organic Agricultural Sciences, University of Kassel

Centre for International Rural Development, University of Kassel

Faculty of Agricultural Sciences, University of Göttingen

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Hochschulverband Witzenhausen e.V.

German Institute of Tropical and Subtropical Agriculture - DITSL GmbH Witzenhausen

The study tour from March 5th to March 20th 2023 was organized in cooperation with the University of Ghana, Accra, the University for Development Studies Tamale, Ghana, the Université de Parakou, Benin and the Université d'Abomey-Calavi, Cotonou, Benin. In particular, we want to express our sincere gratitude to: Prof. Dr. Rodrigue Diogo, Prof. Dr. Martin Oteng-Ababio, Prof. Dr. Georges Djohy, Prof. Dr. Hippolyte Dossa, Prof. Dr. George Nyarko, Dr. Deogratias Agbotui, Dr. Kofi Yeboah Asare, Dr. Sandrine Houessou, Dr. Maurice Ahossoni, Khiddir Iddris, and Frimence Tossou.

In a group of twenty-two BSc and MSc students, one PhD student and two faculty members we followed a very interesting and physically demanding program. Every aspect of the excursion went exceptionally smoothly, thanks to the excellent support of our hosts and the strong motivation of all participants. Therefore, the participating students deserve a big thank you! They worked hard to achieve the goals of this excursion, and besides dealing with hardcore scientific issues, we also had a very pleasant time together.

We really enjoyed this exciting trip with all of you!

Andreas Bürkert

Eva Schlecht

Katharina Hemmler

and, from backstage

Christian Hülsebusch

Achim Dohrenbusch

AGRICULTURE, ECOLOGY, GLOBALISATION AND POSTCOLONIAL STRUCTURES: THE CASES OF GHANA AND BENIN (WEST AFRICA)

Report on the Interdisciplinary Study Tour to Ghana and Benin
by students from the University of Göttingen and the University of Kassel
from 5th to 20th March 2023

PRELIMINARY REMARKS

The Faculty of Organic Agricultural Sciences at the University of Kassel in Witzenhausen and the Faculty of Agricultural Sciences at the University of Göttingen cooperate in teaching and research in order to bundle complementary competencies and offer their students a wide range of courses with attractive opportunities for further study. A recognized field of expertise is tropical and development-oriented agricultural and forestry sciences. Since the winter semester of 2009/10, the joint English-language master's program "International Sustainable Agriculture" is in place. As a deepening of the courses in tropical and development-related Agricultural Sciences, the students of the agriculture, forestry and development economics master's programs at the two universities are offered the opportunity to go on an intensively supervised interdisciplinary excursion once during their master's degree program.

In order to get to know the agricultural and forestry sector of a (sub)tropical country in detail, including upstream and downstream sectors, these excursions should also provide the participants with the opportunity to make contact with students and scientists at universities, national and international research institutions in the host country, in order to stimulate their interest in later tropical and development-oriented scientific work. After seven joint study excursions (Oman 2007, Mexico 2009, Kenya 2011, Thailand 2013, Myanmar 2015, Costa Rica 2017, India 2019), the eighth excursion should have taken place in 2021 and lead to Ghana and Benin. Since it had to be cancelled due to the Corona pandemic, it was rescheduled for 2023. Prof. Dr. Eva Schlecht was responsible for the organization of the excursion; she holds the joint professorship for Animal Husbandry in the Tropics and Subtropics installed by both universities. The practical organization of the excursion was carried out by DITSL GmbH Witzenhausen in collaboration with Prof. Schlecht and Prof. Dr. Andreas Bürkert (Section Organic Crop Production and Agroecosystem Research in the Tropics and Subtropics, University of Kassel).

STUDENT PARTICIPANTS

Participation in the excursion is open to all students who are enrolled in one of the following study programs at the University of Kassel or the University of Göttingen:

- M.Sc. Organic farming (Kassel/Witzenhausen)
- M.Sc. Sustainable International Agriculture (Kassel/Witzenhausen and Göttingen)
- M.Sc. International Food Business and Consumer Studies (Kassel/Witzenhausen and Fulda)
- M.Sc. Agricultural Sciences (Göttingen)
- M.Sc. Crop Protection (Göttingen)
- M.Sc. Integrated Plant and Animal Breeding (Göttingen)
- M.Sc. Development Economics (Göttingen)
- M.Sc. Tropical and International Forestry (Göttingen)
- Diploma in Geosciences (Göttingen)
- Other master's degree programs at the universities of Kassel and Göttingen that allow agricultural or forestry sciences as specializations or minor subjects.

Students must demonstrate that their studies have a tropical or development-related focus, for example by taking appropriate courses and/or internships. The excursion was announced in

September 2022 through a circular email via the student mailing lists of both universities. A total of 31 students applied for a place on the excursion, in the end 23 persons participated. In addition to previous academic achievements, a convincing letter of motivation and good knowledge of English were criteria for the selection, which was made jointly by the accompanying teachers in such a way that the most equal distribution possible between both universities (Kassel and Göttingen) and a balanced gender ratio was achieved.

THEMATIC BACKGROUND

The excursion related to the 17 Sustainable Development Goals (SDGs) from its fields of action for international politics in the 21st century (peace, security and disarmament, development and poverty reduction, protection of the common environment, as well as human rights, democracy and good governance). SDG 1 aims to eradicate poverty in all its forms, especially extreme poverty, by 2030. Closely related is SDG 2, with which the UN aims to end hunger in the world by 2030 and achieve food security and improved nutrition for the entire world population. The UN sees the promotion of sustainable agriculture as the most important means of achieving this goal. With SDG 12, the UN wants to ensure sustainable production and consumption patterns. In SDG 11, the UN emphasizes the sustainable development of cities and communities in the face of global urbanization, which requires the preservation of the natural environment in cities and their surrounding areas. SDG 13 focuses on climate action, SDGs 14 and 15 on environmental protection, and SDG 17 on building a global partnership for development.

Land use, particularly agriculture and forestry, plays a central role in current global efforts to achieve the SDGs. These sectors must not only continue to produce enough food and raw materials for a growing population, but also limit their consumption of natural resources (especially soil, water, energy and biodiversity), i.e. increase their resource use efficiency. At the same time, in the context of global warming, the release of climate-relevant gases associated with the production of food, energy and raw materials from agriculture and forestry must be significantly reduced. In addition, land use systems must be designed to provide regulatory, supporting and cultural ecosystem services in addition to the provision of goods (ecosystem services). Under the influence of increasing globalization, land use systems must efficiently and effectively supply both local and global markets with agricultural and forestry products, while sustainably providing local ecosystem services. This is a major challenge, especially for land use systems in the countries of the Global South.

Particularly in light of SDG 17 - global partnership for development based on equal rights - the discussion about the influences of colonialism and the phenomena of neo- and post-colonialism is gaining more and more space and sheds light on the encounter of different cultures under the changing international power relations from the pre-colonial phase to the colonial era, the phase of the regained independence of the African colonized states up to the present, in which a global partnership at eye level is to be striven for, but at the same time non-European "players" on the African continent increasingly gain influence (China, Iran, Saudi Arabia).

Against this background, our excursion had its starting point in Ghana, which in the pre-colonial period from around 1680 to 1896 was for the most part the core area of the powerful and rich African Ashanti Empire. With its impressive cultural history, Ghana is an ideal excursion destination to discuss global partnership development with a view to achieving the UN development goals against the background of the debate on post-colonialism. The University of Kassel has maintained intensive contacts with universities and scientific institutions in Ghana since 2009 - especially within the framework of its DAAD-funded Exceed Center ICDD - and in this context is increasingly working on questions of political economy, working conditions, the quality of work and distributive justice in relation to the agricultural sector. DITSL projects are currently working with Ghanaian partners and the International Agricultural Research Center IITA on issues related to the development of rural value chains in order to create jobs

in rural areas. There are also contacts with IWMI, the University of Cape Coast and the University of Development Studies in Tamale, all of which were partners in the five-year UrbanFood^{Plus} research project funded by the BMBF (<http://www.urbanfoodplus.org/>) and since 1st November 2022 execute the BMBF-funded project DecLaRe, which is about climate-adapted rural agriculture.

In Benin, there are long-term collaborations with lecturers at the University of Parakou and the University of Abomey-Calavi, many of whom have obtained their doctorates at the universities of Göttingen or Kassel. The sections Organic Crop Production and Agroecosystem Research in the Tropics and Subtropics and Animal Husbandry in the Tropics and Subtropics are directly connected to these partners via the Volkswagen Foundation's "Knowledge for Tomorrow – Cooperative Research Projects in Sub-Saharan Africa" initiative (<http://www.uni-goettingen.de/de/564779.html>). Since 2021, there has also been close cooperation with the University of Abomey-Calavi as part of the DAAD's African Excellence Program Pro-RUWA, while the University of Parakou is a partner in DecLaRe. Overall, the focus of cooperation with the partners in Benin is primarily on issues of empowerment of marginalized population groups (pastoral communities, women), the sustainable use of natural resources with the help of agroforestry systems and the preservation of agro-biodiversity.

The excursion group has fully benefitted from the excellent and long-term partnerships with Ghanaian and Beninese universities, international research centers and NGOs. The various partners had prepared visits to farms, plantations and institutions for the group and discussed intensively with the participants how partnership development efforts can be successfully implemented on an equal footing against the background of the highly conflict-ridden national and international development history.

THE COUNTRY OF GHANA

The Republic of Ghana, with an area of 238,539 km², lies within latitudes 4°44' N and 11°11' N and longitudes 3°11' W and 1°11' E in West Africa between the Republic of Togo to the east, Burkina Faso to the north and the Republic of Côte d'Ivoire to the west. The Gulf of Guinea, part of the Atlantic Ocean, borders the country with 550 km of coastline in the south. The Volta River Basin, including the man-made Lake Volta (the largest man-made water body in the world), dominates the country's drainage system. The largest cities are Kumasi (3.348 million) and Accra (capital, 2.514 million). Ghana owes its name to an ancient West African empire that has no historical or ethnic connection to the current state. Formed from the merger of the British colony of Gold Coast and the trust territory of Togoland, Ghana became the first sub-Saharan country in colonial Africa to gain independence in 1957. Ghana endured several coup d'états until 1992, when democracy with a multi-party system was established.

Climatically, Ghana, which is close to the equator, is located in the tropics and, according to the distribution of precipitation, can be divided into the rainy and therefore warm, humid southwest with its evergreen rainforest areas (2 rainy seasons: April-July and September-November, 1,140 to 2,200 mm of precipitation/year), the warm and comparatively dry southeast (760 to 1,000 mm of precipitation/year), and the hot, dry north with tree, shrub, and grass savannas (rainy season: May-September, 1,020 to 1,400 mm of precipitation/year). The northern savanna areas cover two-thirds of the country. The Harmattan, a trade wind blowing from the northeast, determines the dry season between November and March. The West African monsoon is responsible for rainfall during the rainy season between May and June and September and October. The country has a generally flat relief; the highest point is Mount Afadjato (885m above sea level). Five natural areas can be distinguished on the basis of surface structures: The Low Plains, the Ashanti Highlands, the Akwapim-Togo chain, the Volta Basin and the High Plains. The individual natural areas are very different. Of the original 85,000 km² of rainforest, 40,000 km² remain today and are home to a rich variety of flora and fauna. All of the

country's forests are threatened by increasing deforestation and the export of precious woods - about 1.7% of the forest area disappears every year.

Ghana is considered a multi-ethnic state and is heterogeneous with almost as many population groups as language groups (79 languages and idioms). The official language is English. The largest population group is the Akan (47.5%), whose best-known subgroups are the Ashanti, the Mole-Dagbon (16.6%), and the Ewe (13.9%). Many languages are threatened with extinction as the boundaries between groups become increasingly blurred and individual languages are associated with greater social prestige. In addition to the official language, English, the three most important languages are Asante, Ewe, and Fante. Approximately 71% of the population is Christian, 17.6% is Muslim, and 5.2% are followers of traditional religions.

Ghana today has a population of 29.8 million and an average population density of 133.7 people/km². The distribution of the population varies across the country's ten administrative regions and geographical zones. The population is mainly concentrated in the southern half of the country, with the highest density on and near the coast. With an annual growth rate of 2.18% (each woman has an average of 4 children), Ghana's population growth is the lowest of any country in southern West Africa and has been stable at this level for several years. However, fertility rates in the north of the country are significantly higher than in the growing urban centres in the south. The population is expected to grow to over 51 million by 2050. Ghana's population is very young: 97% of the population is under the age of 65, and more than half is under the age of 24. With 3% of the population over the age of 65, Ghana is one of the countries in sub-Saharan Africa with the highest proportion of older people in the total population. Due to relatively good health care, nutrition and hygiene, Ghana can boast a life expectancy that has been increasing for years (2018: 63.8 years). In a country historically characterized by small-scale agriculture, urbanization has resulted in more people living in cities than in rural areas (56% to 44%). Accordingly, the proportion of workers employed in agriculture has declined from 55.6% (1997) to 34.3% (2017) over the past 20 years, and the proportion of women in the agricultural workforce has declined from 50.4% to 26.8% over the same period.

Economically, Ghana is considered a developing country. However, from 2005 to 2012, the country recorded impressive economic growth, which has slowed significantly since 2013 due to a high budget deficit and inflation, but remains positive due to the country's stable democratic institutions and rich natural resources. Over the past 30 years, Ghana's Human Development Index (HDI) has improved by 31% due to improved access to health care and education, making Ghana one of the few countries in the region with medium human development (142 out of 189). Between 1991 and 2006, Ghana halved extreme poverty from 36.5% to 18.2%, one of the best performances in sub-Saharan Africa. Ghana has also met the Millennium Development Goal of halving poverty and hunger by 2015 (MDG1). However, more than a quarter of the population still lives below the poverty line of US\$1.25 a day, especially in the northern regions (UNDP: Human Development Report 2019- Ghana ¹; FAO, 2015 ²).

Compared to its neighbours, Ghana has achieved a higher level of prosperity and is now home to economic migrants, mainly from Togo, Burkina Faso, Niger, and Nigeria. However, it is still primarily educated Ghanaians who emigrate to the United States and the United Kingdom, resulting in a loss of skilled labour in the country. There is also migration within the country. Development disparities are driving Ghanaians from the north to the south, especially to urban centres. Poverty has declined in Ghana, but it remains widespread in the northern region, which is prone to droughts and floods and has poorer access to transportation and communication infrastructure, markets, fertile farmland, and industrial centres. The northern region has a lower school enrolment rate, a higher illiteracy rate (national average of 21%), and fewer educational and income opportunities for women. Currently, the

¹Available at: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/GHA.pdf

²Country Fact Sheet on Food and Agriculture Policy Trends, Ghana, FAO 2015, <http://www.fao.org/3/a-i4490e.pdf>

lack of affordable electricity, the lack of a solid domestic revenue base, and the high debt burden are among the key economic challenges facing the Ghanaian government.

Gross domestic product (GDP, nominal) was US\$65.5 billion in 2018 (US\$2,217 per capita). Ghana's global economic importance is due to its wealth of natural resources. The country's most important economic sector is mining and industry, which accounts for 24.9% of GDP. Mineral resources include limestone, salt, silver, petroleum, manganese, bauxite, industrial diamonds, and gold. Gold accounts for about one-third of export earnings. Gold, oil and cocoa exports, as well as private remittances from abroad, are important sources of foreign exchange (CIA: The World Factbook, Ghana, 2020) ³.

Agriculture, forestry and fishing contribute 21.2% to nominal value added. The country's major agricultural commodities include cocoa (Ghana is the world's second largest exporter of cocoa), cassava, yam, bananas, and maize, as well as other cereals and fruits. Oil palm, cotton, and coconut are also important cash crops. Food production by smallholders has increased in recent years, but productivity remains low. Ghana is a net importer of agricultural products, importing mainly processed foods such as rice, wheat, sugar, and poultry.

Ghana's agriculture is predominantly small-scale, traditional and rain-fed. Ghana's farming systems vary by agro-ecological zone. However, some universal characteristics are evident throughout the country. Bush fallow is common wherever there is enough land to temporarily abandon a plot of land after one to three years of cultivation. Crops for personal consumption are often grown in mixed cropping systems, while cash crops are usually grown in monoculture systems. In the forest zone, tree crops dominate (cacao, oil palm, coffee, rubber). Food crops in this area are mainly mixed crops of maize, plantain, cocoyam and cassava. The middle belt is characterized by mixed or sole cultivation of maize, legumes, cocoyam or yam, with tobacco and cotton being the predominant cash crops. Cotton and tobacco are also important in the northern part of the country, where sorghum, maize, millet, cowpea, groundnut, and yam are mainly grown. Rice is important in all areas. Approximately 69% of the country's total area is classified as agricultural land, of which 20.7% is arable land, 11.9% is permanent crops, and 36.5% is pastureland. A total of 340 km² of agricultural land is irrigated. About 60% of the farms cultivate less than 1.2 hectares of land, 25% have 1.2 to 2 hectares and only 15% of the farms cultivate more than 2 hectares. The average size of farms is therefore less than 1.6 ha (CIA: The World Factbook, Ghana, 2020).

³www.cia.gov/library/publications/the-world-factbook/geos/gh.html



Ghana politically

<https://upload.wikimedia.org/wikipedia/commons/thumb/2/2a/Ghana-karte-politisch.png/518px-Ghana-karte-politisch.png>



Benin politically

<https://upload.wikimedia.org/wikipedia/commons/5/52/Benin-karte-politisch.png>

Although the majority of rural households keep some number of livestock, livestock is only a supplement to agriculture. Poultry predominates in the south, while cattle are concentrated in the savannah areas. Sheep and goat rearing is widespread throughout the country. In general, ruminants play an important role in the socio-cultural life of farming communities, partly determining wealth and dowry payments, and acting as a bank and insurance in difficult times. Sheep and goats are often slaughtered for various occasions and functions such as births, funerals and weddings (FAO, 2020). Combining crop and livestock production allows farmers to meet their food needs, have access to draught power and organic fertilizer, and generate additional income, especially for farmers in the northern areas of the country. At the national level, the formal livestock sector contributes about 7% of agricultural GDP.

THE COUNTRY OF BENIN

West of Togo and bordered by Burkina Faso, Niger, Nigeria and the Bight of Benin, Benin lies between latitudes 6° and 13° N and longitudes 0° and 4° E. With a land area of 112,622 km², Benin is only half the size of Ghana. The climate is also tropical, hot and humid in the south and semi-arid in the north. Present-day Benin evolved from the West African kingdom of Dahomey. Dahomey was a regional power based on the slave trade between 1600 and 1850 (hence the historical name "Slave Coast"). From the second half of the 19th century, France controlled the coastal areas of Dahomey; the entire kingdom was conquered in 1894. French Dahomey gained independence in 1960; in 1975 it changed its name to the Republic of Benin. A series of military governments ended in 1972 with the installation of a government based on Marxist-Leninist principles. The transition to representative democracy began in 1989. Two years later, free elections marked the first successful transition of power in Africa from a dictatorship to a stable democracy (CIA: The World Factbook, Benin, 2020) ⁴.

Today, Benin is home to approximately 12.9 million people, who belong to more than 42 different ethnic groups. The most important groups are the Fon (38.4%), the Adja (15.1%), and the Yoruba (12%).

⁴www.cia.gov/library/publications/the-world-factbook/geos/bn.html

The official language is French; Fon and Yoruba are widely spoken, especially in the south. Two-thirds of the population lives in the south of the country, with the densest settlements in and around the cities along the Atlantic coast, which is only 121 km long. Most of the north is sparsely populated. The largest cities are Porto Novo (capital, 285,000) and Cotonou (seat of government, 692,000). Nearly half of the Beninese live in urban areas (47.3%). Like Ghana, Benin's population is very young (65% of the population is under 25 years old, and only 2.4% is over 65). However, the annual population growth of 3.4% is higher than that of its West African neighbour (each woman has an average of 4.8 children). The most widespread religion is Christianity (48.5%), followed by Islam (27.7%) and the traditional religion of Vodoun (11.6%), known outside West Africa as voodoo. Due to increasing life expectancy (currently 61.5 years), improved health care and education, Benin's HDI has steadily improved since the 1990s, but is still at a low level (ranking 163rd out of 189 countries; Human Development Report 2019, Benin, UNDP) ⁵.

Similar to Ghana, Benin's territory is mostly flat with some hills and smaller mountains. Benin can be divided into five geographical zones from south to north, beginning with the low-lying, sandy coastal plain (highest elevation 10 m), which is crisscrossed by lakes and lagoons. Behind the coast, the fertile Barre plateaus (from the Portuguese barro - clay; 20 to 200 m above sea level) extend. The Atacora mountain range extends along the country's north-western border into Togo, where Mont Sokbaro is the highest point in the country (658 m above sea level). About 40% of the country is forested. In the south, the original rainforest has been replaced in many places by plantations and crops. North of Abomey, forest and savanna begin to alternate, giving way completely to savanna further north. Benin's diverse wildlife is similar to that of Ghana, and is equally threatened by poaching. Large animals include elephant, leopard, lion, antelope, monkey, wild boar, crocodile and buffalo.

Benin can be divided into southern and northern climatic zones. The south has an equatorial climate with two rainy seasons and two dry seasons. The main rainy season is from March to mid-July and the second, shorter rainy season is from September to November. Annual rainfall ranges from 800 to 1270 mm, depending on the region, and temperatures are constant between 22°C and 34°C, with humidity often uncomfortably high. In the north of the country, there is only one rainy season between May and September, with rainfall of up to 1350 mm. In the dry season, the time of the bush fires, the dry, hot Harmattan blows, as in Ghana. In the month of March, temperatures rise to a maximum of 43°C, especially in the north.

Benin's economic situation is much worse than Ghana's. Poverty is widespread and, together with the rising cost of living and dwindling resources, is increasingly driving Beninese to migrate, especially to other West African countries, especially Nigeria and Côte d'Ivoire. An estimated 4.4 million people—more than 40 percent of the Beninese population—live abroad. Benin's economy remains dominated by the agricultural sector, particularly cotton, which directly or indirectly provides income for a large part of the population. Cotton accounts for 40% of GDP and about 80% of official export earnings. The information on Ghanaian agriculture is largely transferable to Benin, especially in terms of climate, geography and culture. Benin's agricultural land covers 31.3% of the country's territory (22.9% arable land, 5% permanent crops and 4.9% pasture). It is estimated that 70% of Benin's working population depends on agriculture. Yams, cassava, maize, millet, beans, and rice are grown for self-sufficiency in staple foods. In addition to cotton, palm oil, shea butter, peanuts, cocoa beans, and coffee are important cash crops. The rivers and lagoons in the south of the country are rich in fish, but aquaculture has played only a minor role; the livestock sector is based primarily on the raising of cattle, sheep and goats, pigs, and poultry. Mineral resources include iron ore, limestone, chrome ore, and to a lesser extent gold, marble, and ilmenite (a source of titanium). Offshore oil was discovered in 1968 in the Sémé field near Cotonou and has been produced since 1982. Benin's raw materials also include tropical

⁵hdr.undp.org/sites/all/themes/hdr_theme/country-notes/BEN.pdf

hardwoods from the few remaining rainforest areas. Economic and structural reforms supported by the International Monetary Fund and the World Bank have enabled Benin to significantly improve its economic stability over the past decade. After annual GDP growth averaged less than 3.7% between 2007 and 2011, it rose to an average of 5.5% between 2012 and 2014, and has since levelled off. In nominal terms, GDP was US\$25.39 billion in 2017 (US\$ 2300 per capita; FAO, 2020) ⁶.

However, recent economic growth has not significantly reduced poverty in Benin, due to uneven income distribution coupled with rapid population growth. The proportion of Beninese living below the national poverty line has stagnated at around 36% for years. Using the international standard of US\$1.25 per person per day, 50.9% of Beninese live in poverty. In addition, the largely informal nature of the economy, low and declining productivity, particularly in the agricultural sector, and the lack of economic diversification contribute to the persistence of poverty in Benin. Many parents send their children to work as labourers in wealthy households, in mines, quarries or farms within the country or in Nigeria and other neighbouring countries. In addition to poverty, national challenges include inadequate drinking water and electricity supplies, water pollution, deforestation and desertification. The spread of desert into agricultural areas in the north is accelerated by periodic droughts.

LEARNING OBJECTIVES OF THE EXCURSION

The primary goal of the internationally oriented programs in environmental, forestry and agricultural sciences at the University of Kassel (Witzenhausen) and the University of Göttingen is to contribute to a more sustainable design of agricultural production systems in the countries of the Global South by combining basic and applied approaches in teaching and research. Not only primary production, but the entire value chain will be taken into account, with a special focus on achieving the Sustainable Development Goals. For a future-oriented education of students in this field, it is important to get to know and evaluate the main problems of tropical and subtropical agriculture and forestry on the basis of practical experience in the field and to discuss possible solutions in interdisciplinary and multicultural teams. The biennial Great Tropical Excursion has proven to be very successful in achieving this goal, as evidenced by feedback from participants, often years after the event.

The aim of the excursion was to get to know and understand the multifactorial causes for the very different development of the two countries, using the example of the older and more recent history of Ghana and Benin and the current situation of the agricultural and forestry sector. While Ghana presents itself as an economically and politically strong and stable country in the region, Benin is affected by a massive loss of educated, productive people (brain drain, labour drain), although both states have very similar climatic and ecological development conditions. In addition to this basic objective, students will be exposed to core topics in tropical agriculture and forestry, development economics and policy, and international scientific cooperation through case studies and visits to relevant companies, NGOs, consulting, development and research institutions (universities and international centers).

CONTENT PREPARATION AND FOLLOW-UP FOR THE PARTICIPANTS

The participants of the excursion did prepare intensively for the study trip in the winter semester 2022/2023, in tandems contributing to a seminar series on geographical, ecological, historical, political and socio-cultural topics. In addition, country-specific agricultural, forestry and development policy issues were examined (see Table below). The topics developed during the preparatory seminar were deepened in Ghana and Benin through discussions with scientists, farmers and NGO employees at the institutions and locations visited, to increase the understanding of region-specific problems.

⁶<http://www.fao.org/benin/fao-au-benin/le-pays-en-un-coup-doeil/fr/>

During the excursion each participant prepared a half-day protocol; these are compiled on the following pages.

Topics of the tandem student presentations as part of the preparatory seminar

No.	Title
1	Ghana and Benin: Geography and climate
2	Ghana and Benin: Ecology and Environment
3	Ghana and Benin: Pre-colonial history
4	The colonial era under British and French rule
5	Today's government and politics in Ghana and Benin:
6	People and population in Ghana and Benin:
7	Economy and the role of agriculture in Ghana and Benin
8	China's investments in Africa's agricultural sector - a new form of colonialism?
9	Deforestation, reforestation - past and present policies
10	Forests, nature conservation and tourism
11	Roots, tubers and legumes - their historical and current role in human nutrition
12	Plantation crops versus agroforestry systems
13	The West African dairy sector

ACKNOWLEDGEMENT OF LOCAL PARTNER CONTRIBUTIONS

The interdisciplinary nature of the excursion required logistic support and input of valuable content. In Ghana, input was provided by Dr. D. Agbotui, Dr. K. Asare and K. Iddris. In addition, colleagues from the University Ghana (Accra, Prof. Dr. M. Oteng-Ababio), the University of Development Studies (Tamale, Prof. Dr. G. Nyarko) and their teams interacted with the excursion participants. In Benin, too, alumni from the universities of Kassel and Göttingen, who now teach at the universities of Parakou and Abomey-Calavi (Prof. Dr. R. Diogo, Dr. G. Djohy, Prof. Dr. L.H. Dossa), helped in organizing the excursion. We were further supported by Dr. S. Houessou, Dr. M. Ahossoni, and F. Tossou. Due to the very broad and changing composition of the support team, a problem-oriented, interdisciplinary and multinational atmosphere provided the participants with deep insights into the various aspects of development-oriented science and practice.

EXCURSION PROGRAM

Date	Day	Program points	Overnight stay
Sunday, March 5, 2023	1	Departure in Frankfurt/ Arrival in Accra, Ghana	Accra
Monday, March 6, 2023	2	Visit of Sodom slum; urban vegetable gardens	Accra
Tuesday, March 7, 2023	3	Sand mining near Accra; child rescue from slavery (NGO in Winneba)	Accra
Wednesday, March 8, 2023	4	Cocoa cultivation: small farmers vs. large plantations; Yara Glover	Suhum
Thursday, March 9, 2023	5	Cocoa Research Institute, Eco-Park Bunso	Suhum
Friday, March 10, 2023	6	Transfer to Hohoe, on the way: Lake Volta	Hohoe
Saturday, March 11, 2023	7	Hohoe market study, Wli waterfalls and forest	Hohoe
Sunday, March 12, 2023	8	Drive to Tamale, short stops on the way; student night at UDS	Tamale
Monday, March 13, 2023	9	Modern livestock farm, Fulani herders, shea butter cultivation	Tamale
Tuesday, March 14, 2023	10	Transfer from Tamale to Parakou through Togo	Djouougou
Wednesday, March 15, 2023	11	Exploring the village of WeWe; afternoon arrival at Parakou	Parakou
Thursday, March 16, 2023	12	Exploring the village of Boukoussera	Parakou
Friday, March 17, 2023	13	Travel to Abomey: Vertisols, dwarf goat breeding	Abomey
Saturday, March 18, 2023	14	Abomey: Ashanti kingdom (museum); transfer to Porto Novo; cassava production	Porto Novo
Sunday, March 19, 2023	15	Porto Novo: City exploration, Colonialism museum; Ganvié village	Cotonou
Monday, March 20, 2023	16	Free day	Cotonou
Tuesday, March 21, 2023	17	departure at 0:30 am from Cotonou airport to Frankfurt	Flight

DAY PROTOCOLS

MONDAY, 06.03.23, A.M.: AGBOGBLOSHIE – LIFE IN SODOM AND GOMORRAH

MELANIE JOURDAN

After a long journey the day before, the first day of our excursion to Ghana was going to start with learning about and visiting Agbogbloshie, a slum located in the country's capital Accra. A slum that reflects many issues of today's economies and societies: incomplete global value chains, lack of social protection in the informal sector, hazardous work and much more.

Before we could start our program of the day, we learned that things would work differently to what we are used to and made our first intercultural experience, which is time management. While our breakfast took much longer than expected, due to the inexperience of the hotel staff with big groups, the arrival of our guest speaker was delayed. This pattern repeated itself throughout the trip and we had to accept that everything just takes longer than we are used to and being flexible is key in this environment. As we waited, the group made good use of their time and tasted their first of many West African coconuts.

Once Prof. Martin Oteng-Ababio arrived he gave us an introduction to Agbogbloshie as a leading expert in this area and the head of the Department of Geography and Resource Development at the University of Ghana. This was the first of the many times on this trip that we would learn that things are not always black and white and that there is always more than what we see from afar. Prof. Oteng-Ababio first gave us an introduction to the origins of the slum and then went on to discuss the processing of e-waste, including threats and opportunities and lastly talked about the recent conflict with the government that led to the complete demolition of workshops on the site.



It is believed that Agbogbloshie started out in the 1990s, as migrant streams from the north grew. They first started settling closer to the road where nowadays a buzzing market is located and over time moved further away from the road as more people joined. Today Agbogbloshie market is one of the busiest markets of the country and traders from afar come to sell their goods, mostly tomatoes, onions, and yam. Countries represented include Ghana, Niger, Burkina Faso, and Mali. The origin of migrants explains the Muslim majority in an otherwise mostly Christian part of the country. In 2022, about 40,000 people

lived in the suburb of Accra and they process on average 15,092 tons of e-waste annually (Daschner 2023; Owusu-Sekyere et al. 2022). Prof. Oteng-Ababio opened our eyes to the fact that while processing e-waste is an extremely harmful activity for the environment and health it holds unexplored economic opportunities if it is done in a safe and regulated way. At the moment waste recycling in Ghana is mostly managed informally and to a large extent unregulated, creating hazards for the workers, their families, the environment and people living close by. The processing of e-waste at Agbogbloshie is mostly done by young men that burn, leach and dismantle the material to extract valuable materials, like copper, aluminium and gold. Especially the activity of burning creates a hazard as the smoke is inhaled and pollutants are released into the air, for example



causing the pollution of rivers and the soil, as well as dangerous bio accumulation of toxins in the body, such as lead.

The major cause for the informal recycling of mostly imported e-waste is our economies that are not circular enough and are built on buying new and throwing away instead of repairing or selling second-hand. If our economies were more circular, they would entail a solution for the end of the life cycle of electronic items, instead they are thrown away and shipped off to countries in the global south. Estimations state that around 9.5% or 5.1 million metric tons of e-waste are shipped across borders annually (IPIS, 2022). As described above this entails critical problems, however economic and social benefits can be reaped from this opportunity. Firstly, many electronic items that arrive in Ghana can be upcycled and sold second-hand. This holds two benefits, first of all, Ghanaians that could otherwise not afford it have access to electronic items, such as laptops, TVs or smartphones and secondly, this leads to technological spill over and learning effects. Contrary to common belief, the e-waste in Agbogbloshie is not officially dumped there after import, but residents of Agbogbloshie take trucks to drive around the city and actively collect waste for further recycling. Instead of the harmful practices described above, safer solutions are available. This wouldn't include burning the material; however, the process takes longer and as most of the workers live hand to mouth making it not practical for them. The best solution would be to incorporate this informal sector into the global value chain to improve working standards, safety regulations and include them in the social safety net to promote safe processing practices, environmental protection and improve well-being. Moreover, the residents are already engaged in multiple other economic activities, contributing to the economy. These include provision of spare parts, repair services, creation of essential household items, such as pots and school bags and even cattle herding.

However, the relationship between the local government and the residents of Agbogbloshie has been poor in the past. On the 1st of July 2021 the government sent bulldozers accompanied by armed military to demolish the work site. Agbogbloshie has been a thorn in their eye, as they claim it destroys the cityscape and turns away tourism. Formerly Agbogbloshie had separate sites next to each other for work and living, however the demolition destroyed all the workshops, leaving only a GIZ building and a soccer field. This didn't stop the residents from continuing their work, just now they must do it out of their own homes, creating even bigger health hazards for the community.

After the insightful presentation by Prof. Oteng-Ababio, we had the privilege to visit Agbogbloshie personally. We started from the market and moved inwards to the dumping site. On the way we passed many shops, houses, cattle, and workers. Every other corner we stopped for our guides to talk to the next section's leader to let us pass. We could see the processing steps very clearly. At the centre near the



waste site, we witnessed the collection and sorting of waste. Close by the dismantling and burning for extraction of resources took place. For selling these materials huge scales were put up, as well as tents for storage. Going further away from the dumping site and closer to the road other processing steps became more dominant, like repair works. At the road, shops are set up to sell the items or offer repair services. On our way we already got the feeling

that thing work differently than most of us expected from the outside. On the first glance the whole site looks very chaotic, but the opposite is the case. The whole enclave is managed by one chief and at lower levels the section leaders that oversee every activity happening in their area. Additionally, the slum has schools, churches, running water and electricity. This is what we learned from one of the section leaders we were able to talk to. He answered all our questions very openly and was happy to share his experience. Unexpectedly he led us to his cattle herd living right next to the dumping site. He explained that their feed is mostly food scraps and that they are let out to roam freely some time in the evenings. After visiting the slum, we stopped by at the workshop site that has been demolished by bulldozers two years ago. It was a huge contrast to the crowded and buzzing slum, nothing as far as we could see, except the former GIZ health centre that no one has ever used and soccer goal posts. A symbol for the destruction of livelihoods and misunderstanding between the residents, local government and development efforts.

The visit has been a difficult first day, leading the whole group to challenge their beliefs and visualise the privileges we enjoy. After the 2 hours spent at the site, we could just take our clothes off, apply disinfectant and wash out all the toxins, but the residents of Agbogbloshie are exposed to this harmful environment every day. A solution is urgently needed to eradicate the hazardous work and living conditions, but the local government doesn't show much interest in supporting their residents even though they have the power to improve livelihoods and reap economic opportunities.

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MONDAY, 06.03.23, P.M.: WATER RESEARCH INSTITUTE (CSIR ACCRA)

MORENA MERKELBACH

After the long morning in Agbogbloshie, we had a late lunch to digest all the impressions. We really enjoyed our first Ghanaian meal with (among others) "Red Red": Cow beans in palm oil sauce, Gari (Cassava powder) and Aloko (fried plantains). Afterwards, we drove a little further north into the city to visit the CSIR's Water Research Institute. On the way, we were able to gather more first impressions of the city and enjoyed the offers of the flying traders at the traffic lights.

The Council for Scientific and Industrial Research (CSIR)

The Council for Scientific and Industrial Research (CSIR) is an independent and multidisciplinary research organisation in Ghana whose purpose is the development of science and technology. It was established in 1958 and has since become one of the leading scientific institutions in Africa. The research areas are broad and include e.g. agricultural sciences, soil, forestry, nutritional sciences and many more. Overall, the institute strives for innovative and sustainable solutions to address the challenges of Ghana and other countries in terms of poverty and food security as well as health and environmental issues. Through collaboration with other national and international organisations and industry, the CSIR works to improve the lives of people in Ghana and beyond and contribute to economic development. Partners include the Consultative Group on International Agricultural Research (CGIAR) organisation, which represents a global partnership for research on food security and sustainable land use. Next to Nairobi, Accra has the highest density of research institutes in Africa. This may be related to the fact that Accra is a Millennium City, which aims to address the social, economic and environmental challenges of urban communities in developing and emerging countries.

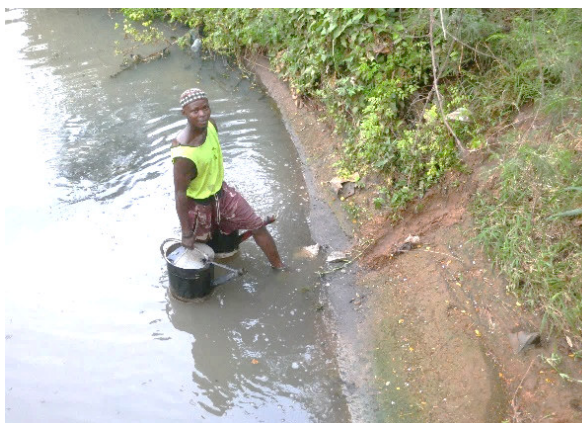
All the institutes are united on the premises of the CSIR. We were welcomed by a staff member of the Water Research Institute and shown around at the site. In addition to countless buildings, the grounds are interspersed with beautiful green spaces. In the many trees, we were amazed at Ghana's rich biodiversity and observed a wide variety of birds.



Cropland at Water Research Institute Area

Water research

The Water Research Institute is primarily concerned with researching the use of waste water. About 20 farmers grow vegetables on the grounds of the CSIR. The fields have been cultivated for decades, so that the town has grown up around them. Nowadays this area is considered as urban agriculture. The land itself belongs to the farmers and they cultivate it independently of the research institute. They produce and sell carrots, amaranth, lettuce, turmeric and mint, among other local crops. It was a wonderful first opportunity to experience the cultivation of foreign species and varieties first hand. Those crops are irrigated with wastewater from the city of Accra. The wastewater is partly taken manually from the river on the site or pumped into a cistern. When the river runs out of water, the cistern is filled with the help of trucks. The water remains in the reservoir for a certain amount of days. In this time the water is cleaned by natural solar disinfection.



Farmer filling watering cans



Farmers at the Water Research Institute area

When wastewater is used for irrigation, it contains nutrients from human waste that can be used by crops. In the absence of manure or other organic inputs, wastewater is a source of organic matter that contributes to soil fertility and enhances nutrient turnover. This is because the organic matter in the wastewater is decomposed by soil micro-organisms, which release nutrients that can be taken up by plants. Overall, the use of wastewater for irrigation can help to improve soil health and enhance the productivity of agricultural systems.

In this way, existing resources can be used efficiently. Especially in the dry season, water plays an extremely important role in vegetable cultivation, as this resource then becomes scarce. Agriculture is

not subsidised in Ghana, so prices fluctuate strongly depending on the availability of resources. In addition, farmers in Ghana tend to mix and apply a lot of cheap pesticides and fertilisers to the land in the hope that it will increase yields. This can quickly lead to over fertilisation. However, little attention is paid to the impact this can have on human health.

Wastewater

This blackwater contains a lot of substantial nitrogen and phosphorus for plants and therefore also serves as a liquid fertiliser. No other fertilisers are used alongside it here. Accra's wastewater contains a lot of wanted and unwanted nutrients and other particles. Only solar disinfection is used to purify the water before irrigation. Surprisingly, the water did not stink at all, which surprised us a lot after seeing and smelling the filthy river in Agbogbloshie. Before providing the water through pumping systems, samples are taken to do analysis. The Water Research Institute is investigating what effects the wastewater can have on the quality of the vegetables, i.e. to what extent it is suitable as a source of irrigation and how such irrigation systems can be implemented.



In the morning we saw that waste treatment in Accra is not well managed (to keep it short) and due to industrial production, agriculture or transportation, we can find a lot of heavy metals such as lead, cadmium, copper, chromium or nickel in the wastewater. For example, lead and cadmium come from batteries and also fertilisers and pesticides can contribute to heavy metal contamination. The results of initial investigations show that the vast majority of heavy metal occurrence in plants were below the limit values and thus the uptake of heavy metals from the wastewater by the vegetables was minimal. Only parsley showed elevated levels, but these would only pose a health problem for humans if more than 2 kg were consumed.

Irrigation at Water Research Institute

Wastewater can also contain a wide variety of harmful microorganisms such as bacteria, viruses or parasites. Those organisms can cause human diseases if vegetables are consumed raw or uncooked. The microorganisms can enter the plant through direct contact with the wastewater but also through water uptake by the roots. Our professors told us that biological contamination of the vegetables is probably not a problem as long as the vegetables are washed with clean water before consumption. Problems could only arise at the markets if contamination accumulates. Another research content is the amount of micro plastic in the wastewater and after irrigation in the vegetables. Particles have been found on the plants, but they probably got there by wind. Results of studies show that no micro plastics were taken up by the plants, except through stomata. The role of softeners is still unclear and needs further investigation. Depending on the plant's intake, they can enter the human stomach through consumption and enter the bloodstream in the stomach. Here, too, the dilemma of science becomes apparent. As Prof. Schlecht said so elegantly at the field: "The more we know, the more we don't know."

Evening

After the visit, we stopped at a nearby mall. It was very western and offered many shopping opportunities with well-known chains. This mall was quite untypical for Ghanaian conditions, but it was perhaps a good transition for the beginning, before we spent the following days/ weeks shopping only at markets. So for the first day, it was a good opportunity to buy travel provisions or other material necessities for the onward journey. Afterwards, we went back to the hotel in the city. There, some of us sat together on the terrace in the evening and processed the first impressions, wrote diaries and discussed. Especially the impressions from the Agbogbloshie slum, the importance of the informal

sector and the political handling of it were topics of conversation. It was a very intense first day in Ghana, with small and big culture shocks. We were able to experience the beauties as well as the dark sides of the city of Accra.

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TUESDAY, 07.03.23, A.M.: TERRESTRIAL SAND MINING: THE CASE OF ACCRA, GHANA

MADELAINE LEA RÜGER

Background

Sand as a construction material has been used for thousands of years, for example in the Egyptian civilization or Roman empire (Asare et al. 2023). Nowadays, sand is still a crucial resource in various industries, such as the fracking, oil and gas industry, for computer chips, glass, textiles glue or paints (Pereira 2020). However, the usage for the construction industry is reported on the most (Torres et al. 2017). The volume of globally demanded resources needed for the construction of buildings and transport infrastructure due to urbanization increased 23-fold between 1900-2010 and is still growing. Sand and gravel make up the largest portion of this material volume and are thus the most used resource in the world, besides water (Leal Filho et al. 2021).

Important to note are the different types of sand based on formation method, size distribution and composition, because despite sand being an abundant resource, not all types are suitable for industrial use (Asare et al., 2023). Deserts for instance make up around 20 % of the earth's land area, but their sand is too fine and lacks impurities necessary for construction use. Appropriate sand for industrial purposes is mostly sourced from marine or terrestrial deposits. Terrestrial sources include river channel and floodplain deposits, and residual soil deposits (Asare et al., 2023) with the latter one being the focus here.

The case of Ghana

Sub-Saharan Africa has one of the world's fastest urbanization rates and is following the global trend of increasing demand for sand with the country Ghana being no exception. The urban population in Ghana increased from 23% (1960) to 57% (2020) due to in-migration to larger cities like Kumasi or Tamale, but especially the capital Accra (Asare et al. 2023). In Ghana, terrestrial sand mining is an increasing problem. Coastal sand mining was banned due to conflicts with fishery and tourism (Dawson 2021) and consequently mostly coarse sand from weathered granite rock is mined, which took millions of years to form. These granite sand deposits are very shallow, ranging from ~ 1-4 meters depth⁸, which leads to large areas of residual surface layers being depleted (Asare et al. 2023). Only in the Accra region, Asare et al. (2023) have estimated a mining volume of around 765 truckloads per day corresponding to roughly 4.55 million m³ of sand annually. This problem of large scale terrestrial sand mining in the periphery of Accra was addressed on the second day and guided by the PhDs and experts Katharina Hemmler and Kofi Yeboah Asare. With them, we were able to visit two sand mining sites and even witness active mining work at the second site.

At the sites

After a brief theoretical introduction by Katharina, we drove to the first mining site westwards of Accra towards the Gomoa East District at the outskirts of Accra. This close proximity of mining activities to city centers is common to avoid long transport distances. Unfortunately, these areas are mostly agrarian communities living on lands owned by chiefs who often prefer quick money over protecting their farmers suffering from the activities because the activities make it almost impossible to farm the

⁸ In contrast to glacial sand deposits in Europe which can be more than 50 m deep.

location after sand extraction. The first site had also formerly been used as farmland but was visibly destroyed. When we arrived, we were told that miners had just stopped working there prior to our arrival, and freshly cleared topsoil was visible (Image 1). Other parts of the area were filled with water and started to overgrow slightly, indicating past mining activities (Image 2).



Image 1: Sand mining site 1; by Madelaine Rüger.



Image 2: Sand mining site 1; by Madelaine Rüger.

After a long drive over bumpy roads, we arrived at a second site and saw around eight young men, a large truck being loaded with sand and two more trucks waiting to be filled. We heard that on this day 15 trucks had already been filled – it was 11:45. Surprisingly, the men did not mind a large group of students and researchers watching them, although the so called “sand winning” is after all illegal without official permission. Mrs. Hemmler told us that many of the workers feel so safe being watched, because prosecution is seldom since the EPA⁹ does not have enough resources and police is often corrupt. The problem with the permits is that they require time (up to 2 years), money and effort which many do not want to or cannot invest. Thus, almost all sand mining is happening illegally, in an environmentally destructive way and at an alarming rate.

The procedure is easily explained: vegetation and fertile topsoil are pushed away and sand is extracted with bulldozers and excavators, creating muddy holes that quickly fill with water and leave vast areas fallow and unusable for farmers who have sometimes farmed on the lands for decades. This way many farmers not only lose their income source from producing and selling cash crops but also areas used for subsistence farming and grazing. It further destroys biodiversity, habitat, creates a breeding ground for mosquitos (due to water accumulation), can pollute local water resources and can also increase temperatures due to the loss of vegetation. In rare cases the topsoil and vegetation is pushed and spread back over the land, which can at least increase the chance of future farming activities.



Image 3: Sand mining site 2 with truck; by Madelaine Rüger.

A sand miner named Godfried talked to us for over 20 minutes and explained that the price for sand is dependent on fuel prices and that filling a truck takes ~ 15-20 minutes depending on the size and weather conditions, because it is more difficult to work with heavy trucks on wet and soft sandy soils with the risk of getting stuck. He also talked about conflicts that can arise at the sites, that many sand miners are armed to protect themselves and that every sand miner has a flag so that customers and workers recognize the mining organizers and mining sites by following the flags. When we asked why the trees are not removed, he said that the fuel price for removing trees with the truck is higher than

⁹ Environmental Protection Agency

the small amount of sand underneath it. With a simplistic mindset, one could blame the miners for the adverse ecological and socio-economic impacts of the sand extraction. However, one should also consider that the workers often live in poverty and depend on the sand mining to provide for themselves and their families. There are often no sustainable alternative livelihoods available which is why a more holistic approach that does not demonise mine workers, but rather addresses challenges along the whole value chain is needed. Thus, Mrs. Hemmler suggested a variety of potential leverage points that could ease pressure on the environment and local communities. These include mining in locations that are unsuitable for farming, finding an alternative to building with concrete requiring sand, building better quality roads to avoid sand being wasted on low quality roads needing repair regularly and strengthening collaboration of local governments, EPA and police to monitor and enforce mining legislation.

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TUESDAY, 07.03.23, P.M.: CHALLENGING HEIGHTS: CHILD SLAVERY IN THE VOLTA REGION

SIMON HEPPE

During our excursion, we encountered many cases of children working at an age where they should typically be at school and not be subjected to harsh working conditions. Some examples were Fulani children herding Cattle, children fishing on the Lake Volta in Ghana, children working in a gravel mine near Parakou in Benin, children being active on markets or children generally carrying around goods from A to B. It became apparent that child labour was widespread and somewhat socially acceptable. Through various talks with people from Ghana and Benin we also got the impression that child labour was often deemed as a necessary mean to support the livelihood of the family as well as showing your children the ropes of the according skill. However, it was hard to determine what exactly the dimensions of child labour, its roots and its causes were. Moreover, it was important to learn more about child slavery, which still poses a big problem in countries like Ghana or Benin.

To learn more about child slavery, we visited the non-profit organization Challenging Heights (CH) in Winneba after spending the first half of the day looking at sand mining near Accra. We arrived in the afternoon and were greeted with a lunch buffet at the office grounds of CHs. Afterwards, we listened to a presentation from Sandra, Communications Officer of CH, explaining the greater context of child labour and child slavery in Ghana as well as the work that CH is doing.

103 300 Ghanaians are living in Slavery and around 2.9 million children are considered “economically active” in Ghana. CH is focusing its work on the Lake Volta region, where around 49 000 children are working and of which 21 000 are in hazardous child labour. The root causes of child slavery and child trafficking in Ghana are poverty, naivety/ignorance, family separation, size and neglect, high profit and low risk and lastly weak policy implementation.

CH was founded in 2003 by James Kofi Annan who himself worked as a child slave along the Lake Volta for seven years. Their mission statement is to prevent child trafficking, reduce child slavery and promote children rights. CH aims to help victims of child labour and slavery, children without parental care and support as well as underprivileged families. CH works on three levels: the individual level meaning the child and its immediate family, the societal level meaning the community where the child

and the family lives and the systemic level meaning the laws, systems, policies, cultural norms, and procedures that are destructive to the care & protection of the child and the family.

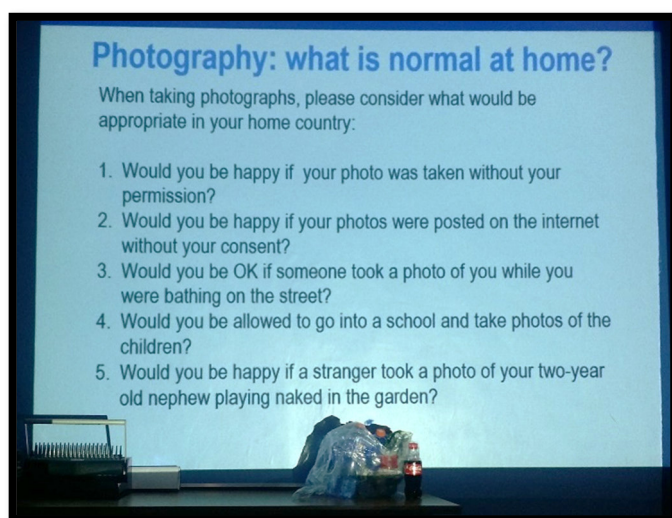
CH divides its work in five thematic areas: rescue, recovery, tackling root causes, research and communication and child protection policies. So far, CH has rescued close to 1 700 children from slavery in the fishing industry on Lake Volta since 2007. They investigate on the ground and on the lake to develop a rescue list and then remove the children from their slavery situations through dialogue, with police and naval support.

For rehabilitation of rescued children, they run a 60-capacity rehabilitation centre where they provide physical and emotional care, basic education, literacy and ICT training, vocational training, medical treatment and nutrition. They also extensively work with families before and after rescue and provide family support through their livelihoods programme. In combination with that, they also monitor reintegrated children and their families for 2+ years with 1-8 visits per month to ensure that the child's needs are met.

CH tackles two main root causes of child slavery: they seek the realization of every child's right to education, and they strive to provide alternative and sustainable income opportunities for deprived families. For education they run the Odobirba Academy which serves over 700 children from Nursery to Junior High School. CH also built up a community library which opened in 2014. They also run a youth empowerment programme where they train young people every year in ICT skills, business and leadership, and sexual reproductive health and rights. To improve livelihoods of affected families, they run a women's economic empowerment programme and offer micro-financing opportunities.

Concerning research and communication, CH aims to conduct at least one major research project each year. Advocacy also plays a key role in their efforts, which they do through meetings with stakeholders, social media and conventional media. They also work together with other international partners.

Finally, CH enforces several Child protections policies in their own programmes. They do not condone any gifts to any gifts to children, people in the community and their own staff. They also ask to be respectful with photography and encourage to ask for permission before taking a photograph.



Photography: what is normal at home? A perspective on photographing people and especially children as a visitor in a foreign country.

After the presentation and ensuing questions, we travelled to the rehabilitation centre of CH for about one hour. As already mentioned, the rehabilitation has capacity for around 60 kids where they are provided with physical and emotional care, basic education, literacy and ICT training, vocational training, medical treatment and nutrition. How a long a child stays in the centre is dependent on the state in which it arrives and how it develops during its time in the centre. Usually, children do not stay longer than two years in the centre.

The centre is a closed off complex and seems similar to other rural schools you might find in Ghana. It had a two-story high building with a courtyard surrounded by the bedrooms of the children, the dining

room and the teachers' offices. It had another building with all of the classrooms next to a big yard on which the children were free to play. Compared to the big office ground of CH, the rehabilitation centre seemed simple and run down.



A look into the dining room (left) and the classrooms along the yard for children to play in (right).

After a short introduction, we were led into the classrooms to interact with the teachers and meet the children who stayed at the centre. While the teachers were very friendly, welcoming, and open for questions, the children seemed rather intimidated and shy. This was very understandable, as we were crammed into their classrooms as a group of around twenty-five strangers. Personally, the whole experience felt very invading, forced, and uncomfortable. Nonetheless, it gave a glimpse of what these children go through and what could be done to help them. We then took some group photos with the teachers as well as the children and left for our next stay in Suhum.



Group photo with the teachers of the rehabilitation centre in front of the classroom.

Reference

<https://challengingheights.org/site/>

WEDNESDAY 08.03.23, A.M.: GHANA'S COCOA SUPPLY CHAIN:
A VISIT AT THE LICENSED BUYING COMPANY YAYRA GLOVER LIMITED
LENA PETRI

The first half of the 3rd day of the excursion led us to the licensed organic cocoa producer and exporter Yayra Glover Limited (YGL) in the Competence Centre of Excellence at Organic Hills, Suhum.

After our arrival, Deogratias, who performed his PhD together with YGL, gave us a short introduction about cocoa production in Ghana. He started with a quite interesting story: originally, cocoa came from South America (Amazon region). Since, in the past, it was forbidden to export seeds from the original region, a Ghanaian man swallowed the seeds to bring them secretly to Ghana. This is when cocoa production in Ghana started.

Nowadays, Ghana produces the world's best quality cocoa. It is the second biggest cocoa producer after Cote d'Ivoire. The production, further processing and export follows a strict process. Licensed buyers (LBCs), such as Glover, buy the cocoa from farmers through middlemen. The LBC checks the quality of the beans. Before the beans can be exported, the Ghana Cocoa Board (COCOBOD), a government agency, controls them and sets a fixed price. After that, the cocoa can be sold to foreign companies.

After Deogratias' introduction, George from YGL presented us their history, mission and operations:

Mr. Yayrator Glover from Switzerland founded YGL in 2007 with the vision to improve income for Ghanaians. In the last 15 years, the company has built a capacity to produce 5000 metric tons of organic cocoa. The organic cocoa is certified (e.g., Rainforest Alliance) by an external body. Today, YGL is the only organic LBC in Ghana. They export their cocoa mainly to foreign countries.

The acquisition of new farmers is performed by visiting local communities and presenting the advantages of organic farming. They try to convince the whole community to go organic to avoid contamination by other fields around the organic fields. If the community is interested, YGL trains the farmers for three years in order to have no residues of dangerous chemicals left in the soil. The farmers receive several (social) benefits from the cooperation: for instance, they pay a premium, which is an extra amount paid for organic beans on top of the fixed price of the COCOBOD. This year, for example, they pay 80 Cedis per bag extra income. The payment of the cocoa producers is made through a corporate bank account of each organization of farmers, which makes the transactions transparent and reliable. Apart from that, YGL provides free organic fertilizer for the farmers, offers trainings, and ensures free health insurance. Moreover, the company encourages farmers to send their children to school and supports schools in the communities with, e.g., learning material.

From the organic fields, which are only treated with the organic fertilizers/ pesticides AgroPy and PhytoGreen-Cacao, 300-400 bags of cocoa beans can be harvested. The farmers write everything in a record book to make their actions transparent.



YAYRA GLOVER LIMITED

OUR IMPACT STORY

- 1 5,000 COCOA FARMERS TRAINED, SUSTAINABLE VOLUMES & PRODUCTION OF CLIMATE RESILIENT COCOA.
- 2 16,000 HECTARES OF ORGANIC COCOA FARMS PRACTICE INITIATIVE.
- 3 CIRCULAR ECONOMY MODEL THAT LEANS ON REGENERATIVE SYSTEMS & ENVIRONMENTAL CONSERVATION.
- 4 ORGANIC COCOA EXPORTS & COLLABORATION TO PROCESS COCOA LOCALLY INTO LIQUOR, BUTTER, CAKE AND NISS FOR EXPORT
- 5 EQUITABLE AND INCLUSIVE STAKE IN COCOA PROCEEDS & ALTERNATIVE-INCOME-GENERATING ACTIVITIES.
- 6 HIGHEST PREMIUM PAYER IN GHANA'S COCOA SECTOR

FOR ENQUIRIES CONTACT:
YAYRATOR GLOVER | YAYRA GLOVER LIMITED | ORGANIC HILL SUHUM
Tel: 0246 488 119 | Email: yayraglover@sunrise.ch

The biggest export market of YGL is Switzerland. But George points out that exporting cocoa bears a big problem for the Ghanaian industry: cocoa is sold as a raw product which does not provide as much income for people as processed goods. So, YGL tries to keep the fabrication in Ghana, create more lucrative jobs for Ghanaians and improve the social standards of the people – short, YGL tries to build a successful industry for organic cocoa in Ghana. But this is not always easy. The major challenge for the company is to be able to buy all the beans produced by farmers, because they produce more than YGL can buy. For this reason, the farmers also have to sell their beans to other companies which do not pay the same premium.

The company FairAfrique, for example, is a German company based in Ghana producing chocolate with the organic beans of YGL. The two companies are closely connected: the founder of YGL is a friend of the founder of FairAfrique. Some years ago, YGL provided FairAfrique land to establish their factory and sells them the processed organic beans to produce chocolate.

Apart from economic operations, YGL also engages politically. The company is, for example, in communication with the COCOBOD about the expansion of organic cocoa production in Ghana.

In the end of his presentation, George showed us a video about future prospects and activities of YGL. In the next years, they aim to go “beyond cocoa” and produce, e.g., baby and dog products, drinks, cereals, and cassava powder.

After the presentation, George lead us in the warehouse (see picture) where normally the beans are stored and transported in jute bags (62.5 kg per bag). In the warehouse, final quality checks are made before selling the beans through the COCOBOD to foreign companies. All jute bags can be traced back to the farmers by the number on the bag. At the moment (March 2023), the season is almost over. This is why the warehouse is almost empty.



George explained to us that the machine (see picture) is used to separate the cocoa beans. They must be prevented from getting moist.

Lastly, George lead us outside to a field directly beside the Competence Center (see picture). At this place, YGL wants to create an agropark. The still young trees have mainly been grown in Ghana, some were brought here from other countries. On the other side of the field, George points to a small factory



that produces essential oils from lemon grass. He finalized his speech by informing us that YGL searches students for working in GIS mapping.

We ended the informative first half of the day by thanking Deogratias and George for the deep insights into YGL and went on to the next program point.

References

COCOBOD, <https://cocobod.gh/>

Yayra Glover Limited, <https://www.yayraglover.com/>

WEDNESDAY 08.03.23, P.M.: SMALL FARMERS VS LARGE PLANTATIONS

CARLOS WILLIAM RODRÍGUEZ CONTRERAS

Agroforestry systems



After visiting the Yayra Glover Cocoa enterprise, we went to a farm with an agroforestry system plantation. It showed a multi-strata arrangement where we could experience the local microclimate cooling effect given by tree's shadows which decreases the soil water evaporation and high temperature conditions (Asistoakor et al. 2022). In this farm the system was arranged with the following species:

Upper canopy layer: Ofram (*Terminalia superba*) and Almond (*Terminalia ivorensis*) which were 6 years old and had already sizes of around 8 m

height. These species are used for wood in the end of the rotation period which is 15 years. That wood is used as firewood, for construction, for tools to smash the oil palm fruits and for the special tool used for preparing Ghanaian typical dish "Fofu". However, currently the use given just for shade generation, also the replanting is being done randomly throughout the farm and the harvesting is done with chainsaw without any safety equipment.

Mid canopy layer: Mother of Cocoa (*Gliricidia sepium*) which is a species used to spread nitrogen, and

give quick shadow to Cocoa, that's why it receives that name. However, they don't give it another use regardless its good reported results as a forage species.

Lower layer: Cocoa (*Theobroma cacao*), this crop had 4 years of being planted and the 60% of the farm corresponds to this crop. We went in the end of dry season, that's the reason because there was no period of harvesting. They have a common disease called Cocoa Blackpod which is avoided currently with pesticides. However, they sell their Cocoa fruits to Glover company.

Randomly among the Cocoa they had Plantain (*Musa sp.*) which is used for short period incomes. Furthermore, we were taught about the origin from the crop and how it is related to colonization processes due to the fact that germplasm came from Brazil originally and the trades of Colonization made that crop arrive to Ghana which nowadays has converted into the second largest Cocoa producer after Ivory Coast.



Understory: Taro, an herbaceous species that is commonly used as food with their tubers which taste similar to Casava and also the leaves are used for cooking with a similar taste to Spinach and grows naturally.

The farmer also has cassava in the 40% of the farm to get short time incomes but these are separated from the Agroforestry system and cultivated alone as a monoculture.

After the agroforestry system explanation, they talked about the Cocoa Life which is a program incentivizing the Agroforestry in the region, also

they talked about how much they can sell to Glover, but then they clarify that they depend on what that company can buy, so they have to arrive at the right moment in order to sell the products to Glover, if they don't arrive in the right moment then they have to sell it to another non certified market.

Land and tree tenure

The main issue of tree ownership is that before it was illegal to harvest the trees. The land belonged to the chiefs but the wood belonged to the president, so in this order of ideas, the forestry commission came to the farms and said what trees were needed to harvest without need of the chief's permission. Later they realized that it was causing deforestation and the law changed, so they allowed farmers to obtain wood for their own needs but weren't allowed to sell. Nowadays the laws changed and they can sell the trees but they have to register it first. There's evidence of a learning process where laws were adjusted to reality.

In the Accra area the things work different. The chief allows mining and then someone can come and take over. Besides that, these areas have migrants, they do arrangements with the chiefs which usually are around a payment with the 30% of the profit earned on the land use. Nevertheless, as the land doesn't belong to them, they can't plant trees because when planting they claim for ownership which is not allowed. This is a problem with afforestation projects where a farmer's land is not theirs they can't plant trees. Some migrants plant *Gliricidia sp.* but not timber trees.

Another obstacle is that within families they have issues as well because the land is divided between the son of the owner when it dies and sometimes the portion of inherited land is too small for production.

Finally, they talked about the younger sons of the farmer and the future of the crop, where not surprisingly there's no hope on the continuity of these system because they are more likely to go to bigger cities to find better job opportunities. Regardless that fact, the future expectations are on

migrants from the north of Ghana who would come in a future and find it as an economic alternative during dry seasons.

Oil palm production village



A man was walking through the agroforestry farm with Oil Palm (*Elaeis guianensis*) fruits on his head, which raised the question of how quick the fruit should go to the production center in order to be able to obtain oil. Based on that interest generated in this large important crop, later in that day we drove to a community where they had a production center for the Palm Oil where there was the whole process with the fruits that arrived there and were smashed to obtain the oil.

This cycle begins when the fruits are split and pressed to obtain oil, then kernels are dried and crack with high heat and: The endocarp is pressed to obtain oil again. Therefore, there are two oils obtained in



this process: First, the Red Oil which is obtained from the pericarp of the fruit, which contains beta-carotene and therefore is used for cooking, considered healthy oil because has unsaturated fats.



Then, they obtain Yellow Oil which is obtained from the endocarp and is not healthy because has fatty acids, is cheaper and is used in the industry and cosmetics.

Finally, they explained there was that the leftovers are used as fuel for the machines, so it is a very efficient process almost cyclic where even wastes are used as inputs to the whole system.

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DAYA SHRESTHA

Following the previous day’s visits to a commercial cocoa distributor and a smallholder cocoa farm, our in-depth look at Ghana’s prized possession culminated with a visit to the Cocoa Research Institute to get a more scientific understanding of the fruit. After a relatively short drive from our hotel in Suhum, we arrived at the institute, where we were greeted with breakfast comprising of an egg sandwich and a locally made cocoa drink. The drink was a simple combination of cocoa powder, sugar, milk powder, and hot water, making it a bit lighter than a milk-based hot chocolate. The rest of the protocol is broken down by the themes that we were introduced to by a staff member during our two-hour stay at the lusciously green and expansive premises of the institute.



History of cocoa and the Cocoa Research Institute



The exact origins of the cocoa fruit in West Africa vary, but it is understood the seeds first arrived on Ghanaian shores from Brazil even though there is some breeding history documented in Mexico. Following an unsuccessful planting in the salty soils of Accra, the fruit was first harvested around 100 km north of the capital, sowing the seeds for a lucrative industry. However, around the 1930s, farmers noticed their plants being ravaged by a viral disease – the swollen shoot virus disease – that became difficult to control. This provided the incumbent British regime with the incentive to set up a designated group responsible for studying the nature of the

disease and ways to protect their cocoa plants. The West African Cocoa Research Institute was formally established in 1938. Following Ghana’s independence, the institution took on its current name – the Cocoa Research Institute of Ghana (CRIG) – and expanded its responsibilities of researching anything and everything concerning cocoa. The CRIG now falls under the jurisdiction of the government of Ghana’s Cocoa Board and receives funding and research support through them. The present-day CRIG’s overarching operational strategy is to identify the problems of cocoa production through close collaboration with farmers and transfer research outputs to them. For instance, they provide organic certification to farms like Yayra Glover and necessary production inputs to farmers.

Research contributions

The research initiative has been designed to ensure the production of the best quality premium cocoa beans in the world. Over the years, Ghana has used



different types of cocoa seeds, each with its positives and negatives. For instance, the Amenolado type of Spanish origin has the best taste but only grows in the northern regions of the country. The Trinitario, originating from Trinidad and Tobago, produces ripe, colourful, and high-yielding pods but is highly susceptible to the black pod disease. The Amazon type can grow very big and is favoured by the farmers, but its quality can be lacking. The institute’s efforts of cross-pollinating the three types gave rise to the hybrid breed, encompassing the best features of all three varieties. The hybrid seed is

the most commonly used in the country. Given the highly commercial nature of cocoa in the country, the seeds' long germination periods can be detrimental. The institute has also contributed to lowering the germination period of these hybrid seeds from 6-8 years to 3-4 years. However, some endeavours continue to elude them. Despite advances in technology and the research progress that has been made, the swollen shoot virus still persists – there is no preventative solution against it yet, only ways to manage the spread and damage.

Divisions

The CRIG has several divisions responsible for overseeing different aspects of cocoa-related research. The soil science division determines the right nutrients and conditions for high growth and yield. The pathology division investigates the black pod and swollen shoot diseases. The agronomic division disseminates information to local farmers on how to plant trees and how other cohabitantes of cocoa can be planted without harming production. The etymology division publishes information on the good and bad insects (e.g. mealybug) so that farmers are aware of what to look out for. In conjunction with the public relations division, it disperses all relevant information through the Ghana Cocoa Farmers newspaper in the form of comic strips and cartoons so that the information is accessible to everyone. The plant breeding division researches efficient breeding and pollination techniques. The physio-biochemical division investigates the chemical effects of soil nutrients, the physical structure of the plant, and DNA composition to determine which breeds are best for breeding and cross-pollinating. The seed production office distributes quality saplings to farmers. These informal nurseries wait for 4-5 months for the seed to germinate before giving away seedlings to farmers during the onset of the rainy season. The quality control division oversees the harvest season and decides whether the harvest is good enough to be put through to the international market.

By-products

The institute also spends a large share of its resources on expanding the commercial prospects of cocoa by-products and adding value to the cocoa production chain. Chocolate beans constitute only 40% of a single pod. The outer husks are dried and made into pellets that are added to animal feed. When combined with starch, the husk also becomes fertilizer suitable for shallow vegetables like tomatoes and garden eggs. Potassium can be extracted from the husks to make potash, which is a key ingredient in making soap. Cocoa beans that don't meet international standards are pressed to make cocoa butter soap and lotions. The pectin inside the seed's core can be processed with fruits to make jam. Cocoa sweating, or the liquid that drains off during fermentation, can be distilled to make alcohol with varying levels of alcohol content, for e.g., dry gin (43%), brandy (40%), and wine (12%). Moreover, the institute has diversified its research focus from just cocoa to other marketable cash crops such as cashews, shea fruit and butter, and coffee.



Sustainability issues

Cocoa needs to grow under a forest since the canopy and shade reduces moisture build-up. Even though the cocoa canopy has fewer trees than a whole forest under FAO definitions, the carbon sequestration effects are similar. The spread of viruses can mean some of the trees have to be cut down. However, the lack of tree diversity and deforestation effects have been touted as potential downsides of cocoa production. Even though greenness in Ghana is associated with cocoa-producing regions, differences from Western standards can make commercialization difficult. The institute's perspective is that despite the merits of various certification standards, they can hurt local farmers whose priorities are more financial. The same argument holds for organic standards where the use of yield-increasing pesticides and fertilizers is frowned upon. In a market where the demand is heavily dictated by the West, the need to abide by Western standards can place an undue burden on farmers,

including deterring them away from engaging in cocoa. I think Professor Bürkert summed up the conversation quite fittingly, with a comment that is apt for not only cocoa but for a lot of other commercial activities in the West African region. “Challenges will continue to exist despite the long history of the institution. There is always scope for new policies and implementation, but the imposition of foreign ideas faces democratic institutional hurdles.”

THURSDAY 09.03.23 P.M.: BUNSO ECOPARK AND CARBON STOCK ASSESSMENTS IN FORESTS

LUCAS WILKE

General information



The Bunso Ecopark, is a forest area founded in the colonial times, with a rich biodiversity.

It is located in the Bunso region in the Abuakwa South municipality (figure 1). It is located at 6°19'29.1"N 0°28'12.0"W. Which is in the south of Ghana with a tropical wet and dry or savanna climate. It has two rainy seasons and an average annual precipitation of 117 mm and an average temperature of 33°C.

The Bunso Ecopark is a 16.5 ha forest reserve which was a genetic resource conservation site of the Centre for Scientific and Industrial Research (CSIR), but was fully converted into a tourist location in 2019. The land is owned by the Akyem Abuakwa Traditional Council who leased it to a mining company in the early 20th century. In 1917 it was then given to another company, the Africa products department for rubber and cocoa plantations. After a few years two British people came and bought the right to use the land and they officially opened the Bunso Ecopark (also named the Arboretum) 1935. After another few years in the year 1946 the administration of the park was given to the Plant Genetic Resources Research Institute (PGRI) of the Centre for Scientific and Industrial Research (CSIR). They managed the park until 2019 when the government decided together with the Akyem Abuakwa Traditional Council and other private companies decided to fully open the place as a touristic facility.

The 16.5 ha large forest is home to 600 species of plants, 105 species of birds, 57 snake species and 300 species of butterflies. At least 19 of those species are endangered and at least the Antacoss Atlas a butterfly species that can only be found in this forest. One of the special tree species, and also the oldest tree in the park with 267 years, is the African oak tree with it enormous buttress roots.

As the Arboretum has been used as a partly touristic place since the beginning of the park, first for British people and afterwards for members of the University of Ghana and for the public, there are also some touristic infrastructures on the area. For example, the guest house, which was build 1935, the canopy walk which was established 2014, or the zip-line. You can do horseback riding as well.

Dangers for the arboretum

As the lease for the land from the Akyem Abuakwa Traditional Council expired there is no security how the future of the whole park will look like in a couple of years. As far as I understood there are still negotiations ongoing with the Akyem Abuakwa Traditional Council and the authorities, but both cannot agree on a price for the lease. Therefore, founding for infrastructure projects is not really possible right now. Another problem is the relative small size of the area and the bordering farmers. As the local chiefs do not properly work against unauthorised clearing of protected forest the farms do gradually grow into the park area.

We first talked about tropical rainforests in general. Tropical rainforests are in many ways different to the forests in European countries. Tropical forests are generally richer in species and sustain a very high biodiversity. There are lots of different tree species, lianas, epiphytes, insects and birds. As water is available in vast amounts and nutrients are also normally sufficiently available, the limiting factor for plants in the tropical forest is normally the access to light. That is why plants in tropical forests have evolved to cope in different ways with the high competition on light. Some just grow really high like the African Oak Tree, others have adapted to grow without the full exposure to the sun light, like the cocoa tree, and others like epiphytes and lianas grow on other trees to get more light. Because of this different plant species, the forest canopy has different strata, namely the forest floor, the understory layer, the canopy layer and the emergent layer. Each layer has its specific species composition, but is at the same time interlinked with the other layers as well.

Tropical rainforest soils are normally very old and there is a lot of heavy rain leading to deeply leached soils. The soils are normally typically reddish, acid poor in nutrients. The nutrient cycle in tropical rainforest systems is due to the high humidity, the high temperature and the high biodiversity so fast, that almost all the microbial activity happens on the ground or just a few centimetres below the surface and there is no chance for a humus layer to evolve. That is one of the reasons why trees like the African Oak Tree, form those immense and typical buttress roots. As most of the nutrients are in just few centimetres below ground, and water is not an issue, trees do not grow deep roots into the soil. Without the stability of a deep and strong root system underground, the really high trees are missing some stability. The buttress roots are a good option for trees without deep root growth to maintain their stability.



After we discussed a little about tropical rainforests, we tried to assess the carbon stock in the arboretum. For this task the group was divided into two subgroups, each performing a different method to measure the average biomass per hectare. The first group did the assessment with the angle-count method. The angle count method is a method where the researcher stands at one point in the forest. We had a close pin attached to a string to create a fixed angle of view. With that tool the person looks around and counts every tree that completely fills the fixed sighting angle. Trees that are too small or too far away to fill the sighting angle are not counted. The second group went to another place in the forest and measured the height and the diameter at breast height from every tree with more than 20 cm diameter in a 10 x 10-meter square.

Based on the diameter the basal area of the trees in their location, both groups multiplied that value by the height and by 0.5 to calculate the total wood volume. The total biomass weight was then calculated by multiplying the volume with the density, which was estimated to be 0.6. The total carbon stock is equivalent to half of the total biomass. Rather surprisingly, both groups estimated a similar amount of carbon stored in the trees of the arboretum. However, these estimates could be far away from the real value, as we did not take into account that different tree species have different wood densities. Furthermore, more sampling points would have been needed for a proper forest inventory, and tree height should have been measured more accurately. Nevertheless, according to our measurements around 1,200 tons of carbon are stored within the arboretum.

	Group 1 Results	Group 2 Results
Total basal area:	36 m ² /ha	18 m ² /ha
Average tree height:	13.3 m	28.25 m
Volume:	36 m ² /ha x 13.3 m x 0.5 = 239.4 m ³ /ha	18 m ² /ha x 28.25 m x 0.5 = 254.25 m ³ /ha
Biomass:	239.4 m ³ x 600k g/m ³ = 143,640 kg/ha	254 m ³ x 600 kg/m ³ = 152,000 kg/ha
Carbon in biomass:	143,640 kg/ha : 2 = 71,820 kg C/ha	152,000 kg/ha : 2 = 76,000 kg C/ha
Total C in arboretum:	71,820 kg C/ha x 16 ha = 1,149,120 kg C	76,000 kg C/ha x 16 ha = 1,216,000 kg C

FRIDAY 10.03.23 A.M.: TRIP TO HOHOE WITH STOPS FOR OIL PALM PLANTATIONS AND LAKE VOLTA

SVENJA HEMGESBERG

We started early in the morning with our departure from Suhum to Hohoe, approximately 222 km laid ahead of us. On the way we stopped on plantations and did a boat trip across Lake Volta.

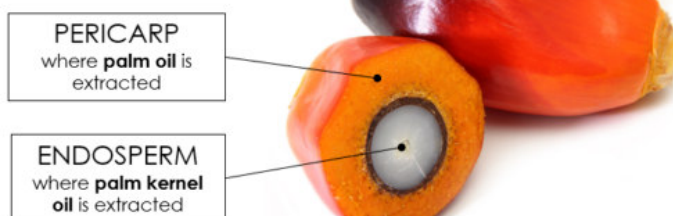
Oil palm plantation

Our first stop was at an oil palm plantation where Professor Bürkert shared some fascinating insights about the cultivation of palm oil. Oil palm is a highly prized crop, particularly in West Africa where it is indigenous and has been cultivated for centuries. The two local types of oil palm trees found in Ghana are Nana type and a bigger type. Nana types are smaller and have a shorter life span, with harvesting possible after three years, while bigger types can be harvested for the first time after five to six years and have a lifespan of 40-50 years. Oil palm trees have a high photosynthesis rate and are also capable of fixing nitrogen, which creates habitats for microfauna. Plantations are usually established with palms planted at 12 x 12 m intervals. As the palms grow and their canopies close, the plantations are



Oil Palm Plantation

susceptible to high erosion, especially during heavy rains. To mitigate this, mulching or planting cover crops are recommended.



Oil palm fruit (<https://paaconsulting.com.sg/sustainable-palm-oil-not-an-oxymoron/>)

The fruit set of oil palm trees can weigh up to five kg and can be harvested up to 15 times a year. It's crucial to harvest quickly as the outer layer of the fruit ferments rapidly after harvesting, making it unsuitable for consumption. The kernel oil

from the fruit is mostly used for cosmetic purposes due to its low quality and low fatty acid content. Although the use of palm oil for biofuels is marginal (5% worldwide), it is considered an industrial product, with most of it being used for food. The pericarp of the fruit is high in beta carotene and is an important source for nutrients and significant source of oil in West Africa. It's also the most important oil crop globally, with high yields of 3000-5000 kg/ha. In the western world its mainly used as a cheap alternative for dairy products, where it's found in small quantities in biscuits and convenience food. Critics often raise

concerns about palm oil's impact on the environment, particularly the loss of biodiversity due to the clearing of rainforests. However, it's still considered a cheap alternative to dairy products.

Boat trip on Lake Volta

We continued our journey towards Lake Volta. Upon arrival, we had the opportunity to try regional dishes such as fried snails and fried cassava. We took a small boat trip across Volta Lake with fishing boats that were very long and narrow and occasionally had water running into them. A nice opportunity to get out of the car and see the area from a different perspective. There was also the opportunity to get sporty and take the rounds in hand. We rowed under the famous Volta Lake Bridge and saw the fishing nets of the local fishermen.

The Volta Lake is an impressive body of water in Ghana, created as a result of the construction of the Akosombo Dam on the Volta River. With a surface area of over 8,500 square kilometres, it is one of the largest man-made lakes in the world. The lake provides many benefits to the people of Ghana, including irrigation, hydro-electric power, and transportation.



Boat trip on Lake Volta

Fishing is also an important economic activity around the lake, with fishermen using traditional methods to catch various species of fish. In addition to fishing, the Volta Lake has become a popular destination for tourists, with many opportunities for water sports such as boating, kayaking, and swimming.

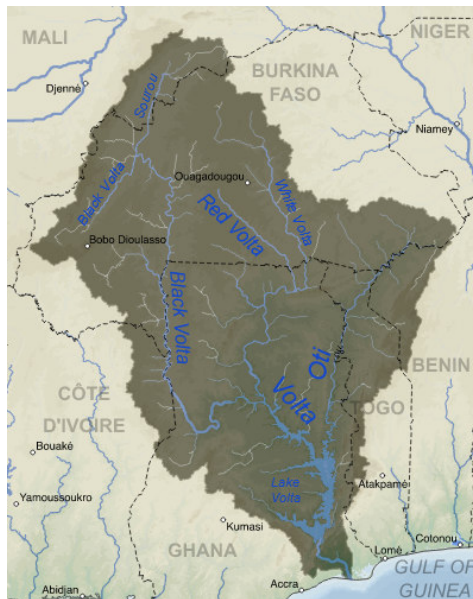
Afterwards we went to a regional fish market, where all kinds of freshly caught fish were sold. This was our last stop before reaching our destination in Hohoe and we said goodbye to Kofi, who had accompanied us until then and contributed to a successful trip.



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Geography



Lake Volta complex (Pepper 2018)

Lake Volta is situated in South-eastern Ghana. It is 8.482 km² in size. The lake is being supplied by the Volta River, which is a confluence of the Red Volta, the White Volta and the Black Volta. Next to the Volta River supplying Lake Volta, also the Oti River is a noteworthy distributor of water.

On our journey from Suhum in the Eastern Region of Ghana to Hohoe in the northeast, we travelled the Volta region and passed Atimpoku. In Atimpoku we had the chance of doing a canoe-ride, crossing the Kpong Headpond. The Kpong Headpond is part of the Lake Volta and Volta River complex. The ride was south of the big dam of Akosombo which is the reason for the existence of Lake Volta and north of Kpong dam.

Historical background

Starting in 1949, before the nation of Ghana was founded, the Gold Coast Government commissioned British consulting engineers to examine the plans of the Volta River Project. Until the report from the British Consulting engineers was published, the Gold Coast Government made its own research which resulted in a need of a port to serve Accra. In 1951 the results of the report came to the solution, that a harbour in the east would be essential. In the same year a new government was elected. The plan stayed and in 1953 a Volta River Preparatory Commission was established. In 1956 the Commission made its statement, which said, that it is economically and technically feasible. Before and after the independence of Ghana in 1957, extensive meetings have been held with the government of the United Kingdom and other governments. But building a dam is very expensive and the production of aluminium was very stressed at this point of time (aluminium was needed to build the dam). The other governments wanted Ghana to have a proper arrangement with the interested aluminium companies. The interested aluminium companies wanted Ghana to have certain factors to be assured beforehand. For example, the cost of power, which Ghana only can ensure, when there is an ensured arrangement with the supporting other governments, which would lend money to Ghana to finance the Volta dam project. President Dr. Kwame Nkrumah visited the USA in 1958, and already in 1959, a new report with recommendations came up. The planned local refinery to make aluminium from bauxite got a pruning back, but the total power production would raise, which could maybe later make the local production of aluminium more feasible. The power generating capacity would be raised on about 22 times the power generating capacity of Ghana in 1959. In 1962 also an agreement on an aluminium smelter could be made. The Parliament passed the Volta River Development Act and established a Volta River

authority, which has the responsibility of planning, executing, and managing the development of the Volta River. This includes construction and operation of the dam and the power station and transmission system. Besides that, this authority was responsible for nothing less than controlling the 8.482 km²-lake (for comparison: the state of Hesse, Germany comprises 21.115 km²) and developing the lake for fishing, transport, communications, plus promoting the health and welfare of population around the lake area (GhanaWeb 2023).

Fishery and fish at Lake Volta

For the opportunity of fishing, an adequate abundance of fish is necessary. In Ghana, fish and fish products provide nearly 70% of the country's animal protein requirements and Lake Volta produces more than 90% of the inland freshwater fish. In the beginning of the formation from a river to a lake, the composition of fish species has changed. The change from a riverine condition to a lacustrine condition brought death to different kinds of fish species. Widespread known and eaten are Tilapia. Several types of it can be found in Lake Volta, e.g., *Sarotherodon galilaeus*, *Oreochromis niloticus* and *Tilapia zillii* (Béné 2007). Beside Tilapia, there is a big abundance of catfish. Especially *Chrysichthys* spp. and *Synodontis* spp. can be caught (Béné 2007). On the trip we learned: Near the banks of the lake there can be a cover of leafy matter. Underneath that layer of leafy matter, catfish can be found. To catch those catfish, the layer of leafy material is being removed and thereby the catfish are being startled and can be caught easier. Added to that, the leafy matter can be utilized further, e.g., for composting.

The fishing is often done artisanal with canoes and small nets or through spearfishing. When the fish is caught (mostly by the fishermen), women buy it from them and sell it on the market. It is sold very fresh in one piece. If requested, the women gut out the fish as well (Nelson 2023). On the trip we saw that people are make a living from either fishing, selling fish, offering canoe-rides or many more jobs.



Tilapia with Fufu in light soup (yen.com.gh 2023)



Kid fishing with net (Erhardt 2023)

In restaurants Tilapia is served in mostly spicy soups like light soup, groundnut soup, leafy soup or palm soup and added to that fufu (dough of boiled cassava and plantain) or banku (dough of fermented cassava and corn).

Lake Volta and the towns around it are a popular for inland tourism. The markets have a big variety of products to offer. According to Prof. Schlecht, the towns are less crowded and cheaper than near the coast. On the trip we had the chance of doing a Canoe-Ride in the Kpong Headpond. Starting point of the Canoe-Ride was in Atimpoku underneath the Adomi-Bridge. The Canoe-Ride took around 30 minutes and gave us the chance of seeing vegetation from the water and listen to some words of the canoe-guide Abraham.



Adomi-Bridge with us underneath (Hemmler 2023)

The Adomi-Bridge is Ghana's longest suspension bridge. A sign on the bridge from 2015 reads as follows: "Volta Bridge/ Adomi-Bridge was built in 1955-1956 and unveiled by the honourable Kwame Nkrumah prime minister of the Gold Coast, on 25th of January 1957 to commemorate the opening of the bridge by his excellency sir Charles Noble Arden-Clarke, governor of the Gold Coast." Reading phrases and wordings like: "honourable" or "by his excellency" on a plaque or hearing such a sovereign vocabulary on talks at the university from professors is quite unfamiliar to me. I concluded that it has to do with how people are raised in different cultures. As a person who has been raised in the south of Germany, I learned: "Nothing said is praised enough". In Ghana it felt like the exact opposite, which would mean: Even if things are going not very well, they are being praised up to the skies. Therefore, I personally am having a hard time to trust peoples' assessments.

Coming back to the work of the people around Lake Volta: Our canoe-guide Abraham started helping his dad fishing at the age of five years. Thinking about that a cross reference to day two, on which we visited an organisation which fights child trafficking can be made: There is child labour and child forced early marriage (CFEM) around Lake Volta. CFEM is a practice to set in motion a dependence syndrome to ensure the children will continue working for their slave masters when they become adults (Tsekpo 2016). Me as a student, not being sensitised or well informed about the topic of child labour or slavery beforehand, I didn't realize, that children who help working during the day or even being on their own on a boat, could mean, that they are in fact working instead of going to school or kindergarten.

To differentiate between childcare, early apprenticeship, child labour and slavery can be hard. In Germany it is common to have childcare like kindergarten or later compulsory education paired with a strong formal sector (which ensures children effectively go to school). It seems like the Ghanaian system still has a weaker/ smaller formal sector and therefore a lower level of education.

People around Lake Volta obviously can take their children fishing with them, which could be a kind of childcare while working. Meanwhile, children start helping and learning how to fish at an early age. This could be seen as passing on from traditions, early practical education, or child labour. Some people might not have the chance of bringing their children to work. There are known cases of parents bringing their children to "uncles" or other people, who take them fishing or take care of them in other ways, which can be called some kind of slavery already.

Conclusion

This day included many hours of bus riding. It was the first time we rode many kilometres into the north. The stops we made were interesting and delicious. We had the chance to try Abolo, which is a dough of corn with sugar inside a leaf. After the Canoe-Ride we drank coconut milk from fresh coconuts and ate the pulp. In the evening in Hohoe the group was rewarded with the nicest accommodation on the whole trip and dinner in the lobby.



Abolo (Rüger 2023)

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SATURDAY 11.03.23 A.M.: MARKET ACTIVITY IN HOHOE: FIELD RESEARCH

ALISHA WEBER

On the 11th of March 2023 the original program was changed to conducting field research on the local market in Hohoe. The initial objective was to have a scientific program point. Originally a visit to a monkey sanctuary was planned, but it turned out to be more than two hours of driving and a more scientific input for the students was aspired.

Hohoe is a town located in the Volta Region of Ghana, West Africa. It is the capital of the Hohoe Municipal District and serves as a major commercial and administrative center in the region. The Hohoe District was established in 1979, separating from the Jasikan and Kpandu District Councils. It has a total land surface area of 1,172km² representing 5.6% of the regional land size and 0.5% of the national land area. The district is home to several major ethnic groups, including the Ewes, Akpafu/Lolobi, Santrokofi, Likpe, Logba, Tafi, and Nyagbo (Ocloo & Subbey 2008). The Ewe people are the predominant ethnic group in the area. The current population of Hohoe district is 167,016 and comprises 52.1% females and 47.9% males, while the town of Hohoe has approximately 56,000 inhabitants (The Official Website of Hohoe Municipal Assembly, 2023).

The economy of Hohoe is mainly agrarian. The fertile lands in the surrounding areas support the cultivation of crops such as cocoa, maize, cassava, yam, and vegetables. The Hohoe District is situated in the transition zone between the forest and savannah ecological regions, making it a part of Ghana's designated food production zone. The district experiences a bimodal rainfall pattern, with the major rainy season occurring from April to July and the minor rainy season from September to November. In some cases, rainfall can persist continuously from April to November. This bimodal pattern enables two distinct farming seasons. The annual rainfall in the district ranges from 1100 mm to 1500 mm, with

an average of 1300 mm. The cultivation periods span around 200 to 220 days, providing ample time for growing various food crops (Dzivenu 2014).

In March 2023, Ghana witnessed an inflation rate of 45% and a significant drop from the high of 54.1% recorded in December, which had been the highest in over 20 years. The relative stability of the Cedi since January has played a role in this improvement, with expectations of a forthcoming agreement with the International Monetary Fund (IMF) or a \$3 billion bailout further contributing to the positive sentiment. In terms of specific categories, food inflation amounted to 50.8% in March, while non-food prices experienced a deceleration in growth, with a rate of 40.6% (Ghana Statistical Service 2023).

Among others, due to these recent developments in the Ghanaian prices, conducting field research on a major local market hub and engaging with the local community was judged as a better and more scientific alternative to the abandoned sanctuary visit.

In the morning the students had around 25 minutes to organize themselves. They decided to split into four groups: one group that is responsible for the geographical mapping of the market and three interview groups that operate at three different geographical areas in the market where they interview the people working in the shops. For the interviewing a questionnaire (Table 1) was compiled beforehand to ensure that the results are consistent and comparable among the different groups.

Table 1: Our market questionnaire

1. Type of shop	7. Is the person working in the shop also the owner of the shop?
2. Gender of the workers	8. Origin of products
3. Age of workers	9. Taxing/administration
4. Origin of workers	10. Number of workers
5. How long did they work there? How long has the shop/stand been there?	11. Have the prices changed recently?
6. Working hours	

Departure time was 9:30 a.m. from the hotel to Hohoe local market. The market research started at 10 a.m. and the groups split. Chainsaw Plaza at Hohoe was marked as the most southern border of the

Table 2: Type of shops at Hohoe market

Type	Freq.	Percent	Cum.
2nd Hand & Shoes	1	3.33	3.33
Bank	1	3.33	6.67
Beverages	5	16.67	23.33
Beverages & snacks	1	3.33	26.67
Chemicals	1	3.33	30.00
Clothing	5	16.67	46.67
Commodities & Gas Station	1	3.33	50.00
Electronics	1	3.33	53.33
Food	1	3.33	56.67
Food & Beverages	1	3.33	60.00
Food+ house items	1	3.33	63.33
Food, Beverages, Commodities	1	3.33	66.67
Food, Commodities	2	6.67	73.33
House items	1	3.33	76.67
Ice cream	1	3.33	80.00
Mobile money	1	3.33	83.33
Phone, Charger	1	3.33	86.67
Plastic items	1	3.33	90.00
Street Food	1	3.33	93.33
Wholesale (Beauty, Shoes, Socks)	1	3.33	96.67
Yam (Food)	1	3.33	100.00
Total	30	100.00	

market and the teams should not interview any shops more southern than Chainsaw Plaza. The groups had until 1 p.m. to finish compiling the market research and gathering the interview results as well as the geographical map of the market. It was also indicated that the groups should have had lunch on their own before meeting again at 1 p.m.

The groups had different techniques to handle the questionnaires. Some split into subgroups of two persons, with one "interviewing person" and one "writing person" that noted everything that has been said in the interview. Other groups (5-6

people) stayed together and interviewed the workers on the market as a group.

Table 3: Number of workers per shop at Hohoe market

Number of workers	Freq.	Percent	Cum.
1	9	31.03	31.03
2	12	41.38	72.41
3	3	10.34	82.76
4	4	13.79	96.55
6	1	3.45	100.00
Total	29	100.00	

electronics, clothing and banks. In 23 of the interviewed shops (76.7%) the owner was also working in the shop, while in seven of the shops the owner was reported to not work in the shop (23.3%). The number of workers per shop ranged from 1 to 6, with a mean of 2.2 (Table 3). Most interviewees were

Table 4: Origin of the workers

Origin of workers	Freq.	Percent	Cum.
Brazil	1	3.33	3.33
Ghana	3	10.00	13.33
Ghana (Accra)	1	3.33	16.67
Ghana (Volta Region)	17	56.67	73.33
Niger	3	10.00	83.33
Niger/BurkinaFaso/ Mali/Ghana	1	3.33	86.67
Nigeria	1	3.33	90.00
North Ghana	2	6.67	96.67
Togo	1	3.33	100.00
Total	30	100.00	

reported that their products originated from Ghana, while the remaining 17.8% originate from China, Israel, or Togo.

Most individuals report to work 12 hours per day (31.0%) which also represents the mean of the reported working hours. As an additional observation, it was reported by many individuals interviewed in the first group, that the prices have heavily increased within the last months. Some reported that the prices have more than doubled in the last half a year.

Overall, the data reflects a variety of businesses in the Hohoe area, including clothing, food, beverages, electronics, banking, and more. Some businesses have experienced price increases, while others have remained stable. The ownership is a mix of male and female, with a range of origins for both workers and product sources.

Speaking for myself, this was one of my favorite days because we had the opportunity to interact with the locals and learn more about their day-to-day reality. Additionally, we could learn about the produce that is sold at local markets. Some people that we interviewed were very welcoming and open to share personal things or also struggles they are facing. What was most shocking for me, were the working hours of the people. Most of them spend almost every day, the entire day, at the market trying to make a living for themselves. And mostly, the hours that they referred to were the opening hours of the shop, which would for example not include the procurement of the products if they have to be picked up somewhere. What was also surprising, was that some shops even disclosed the taxes they are paying or the income that they are making per day. One little stand with a Togolese owner told us that every day someone comes to collect 1 Cedi of him in addition to the regular taxes he pays for the shop, which actually none of the other shops reported. He also told us that this is some sort of premium he has to pay for not being from here. What probably was most shocking for me were the price increases that people reported. Almost everyone we interviewed in my group told us that the prices for sourcing the products increased and sometimes even more than doubled. If looking at the inflation

To get a better idea of the gathered data, I combined the different Excel files into one sheet that I then imported into Stata. There I tabulated and summarized the observations for the different variables to obtain mean values.

In total 30 shops were interviewed. The shops included a range of different types of shops (Table 3), including among others beverages, food, commodities, from Ghana (23 individuals, i.e. 76.7%), ranging from Accra to the North of Ghana with the majority originally coming from the Volta Region (17 individuals, i.e. 56.7%) (Table 4).

The mean age of the interviewed workers amounts to 33 years, with the youngest observed age being 18 and the oldest observed age being 65.

Of the interviewed shops, 82.1%

rate in Ghana of course that makes sense. However, it gives you a different understanding and a special form of compassion to talk to people in the market about these changes and their impact on their lives.



Impressions from the market survey in Hohoe

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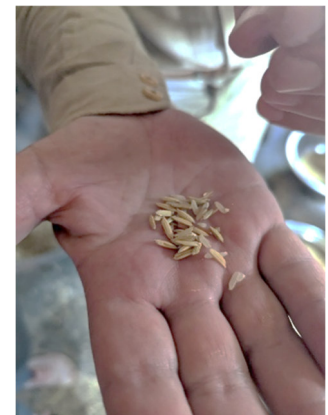
SATURDAY 11.03. 23 P.M.: RICE CULTIVATION IN THE VOLTA REGION
AND THE TALLEST WATERFALL IN WEST AFRICA
EVA-MARIA POERTERS

On our way through the Volta Region we stopped in Hohoe, the capital of the eponymous municipality east of Lake Volta and close to the Togolese boarder. This region is hill-strewn with some wet areas which makes it one of the main rice production regions in Ghana. In the whole of Africa, there are two main rice production centres: Guinea and Ghana, in the highlands. Worldwide rice is grown either as paddy rice under irrigation (50%), rainfed lowland rice (30%), or upland rice (11%).

Rice is one of the three most important grains worldwide. In 2022/23 around $502 * 10^6$ tons (milled) rice was produced, surpassed only by maize ($783 * 10^6$ tons) and wheat ($1,151 * 10^6$ tons). Around 7.5 billion people could be fed by only those two crops - wheat, and rice. The others could be fed on other grains, for example maize. Therefore, maize should not be fed to animals but used for humans to meet the goal of zero hunger.

Rice economy in Ghana

Rice consumption in Ghana is high (only beaten by maize) and demand is rising due to urbanisation, population growth and changing consumption patterns as a result of economic development. However, the domestic rice supply falls short of meeting the demand and thus relies heavily on rice imports. In 2021, Ghana was the 13th biggest rice importer worldwide and rice the 3rd most imported good of the country. The self-sufficiency rate currently lies at 43%. Local rice production is at risk since the rice value chain, among other things, is far from being competitive because of the inefficiency of the seed systems, low productivity, inappropriate harvesting methods, high milling, storage and transport costs, and the same time, low capacities. In addition, local people consider local rice to be of inferior quality and are not very willing to buy it.



White rice with husks

Rice production and uses

After a market visit and systematic familiarisation with its organisation and structure, we found a small-sized rice mill at the back of the market area. Though the mill was small, the entire production process from the arrival of the rice bags to the finished white rice is carried out here. Rice production consists mainly of two parts: cleaning and polishing. After the harvest, the local rice farmers come with their bags full of rice (still in their husk) directly to the mill, where it gets further processed. In bigger, commercial mills the whole process is done by machines, but in Hohoe we could experience every part individually done by smaller machines and partly manually. In the first part, rice needs to be cleaned of straw leftovers, little stones, and empty husks. This is done by throwing the rice around in a small machine. In the second step, the rice gets separated from the husk and polished, so that only the white rice remains. The number of polishing circles depends on the miller. Here, we saw the miller polishing twice – after the first round, he pours the rice from the large silver bowls into the machine again, where the husks are separated from the rice with the help of wind and friction. Minerals and proteins, mainly Vitamin B1 and B6, Magnesium, Phosphorus and Selenium, which sit right around the starch, get polished away and are lost in the process, the more the outer layer comes off.



Part 1: Cleaning the rice

To solve the problem of hidden hunger, biotechnological methods were used to enrich rice with beta carotin (provitamin A). This resulted in the so-called Golden Rice, whose name was derived from its yellowish colour. Three main problems came up with breeding: first, the quantity of additional beta carotin achieved was still too small to improve the situation. Secondly, rice itself is a culture, or better: “religion”. Culturally, other rice but white rice did barely find acceptance and the consumers were not convinced enough, i.a. because of lack of education and knowledge gap. And lastly, other food substitutes like maize were too strong, so that Golden Rice did not meet its goal to solve the problem of hidden hunger.



Part 2: Polishing the rice

Besides the main product, white rice, side-products can be used for further processing: the husks serve as animal feed or for biochar production, broken grains can be used for flour, even rice wine or beer production is possible. However, economically the demand for the different by-products must be considered. For example, rice flour is rarely used in Ghanaian kitchens and exports are not financially sustainable. Also, the husk ash is not necessarily convertible into biochar because of its high acidity (husk ash consists mainly of silica). Lastly, the high C/N-ratio of the husks negatively affects the quality in terms of composting.

In Ghana there are many small farms like the one we visited. However, the government wants to increase productivity of local farmers, so rice production is now to be more formalised and supported by bigger commercialised factories, especially to reduce the dependency on rice imports and create job opportunities. In Northern Ghana, the Savelugu

Municipal Rice Processing Factory was inaugurated a couple of months ago in December 2022, and it is supposed to create job opportunities, as well as to develop and extend the value chain in rice production. Additionally, young people will be trained in managing the factory and passing knowledge to the farmers to improve their raw materials.

Rice cultivation

There are two main subspecies of rice (*Oryza sativa*): *Indica* rice and *Japonica* rice. They can be distinguished in their taxonomy by their agronomic characteristics and stickiness. While *Indica* rice has slim grains and is cooked not sticky, *Japonica* rice has round grains and is cooked sticky. The different stickiness comes from the different proportions of amylose and amylopectin in the grain. *Japonica* has a higher share of amylopectin and lower (almost no) share of amylose in its starch-corn. While cooking the rice, amylose dissolves easily in water, whereas amylopectin is difficult to dissolve due to its large molecular structures and thus makes the rice sticky.

Wii waterfalls



For a nice final touch, we visited the Wii Waterfall at the end of the day. With its approximately 60 m height, it is the tallest waterfall in West Africa, located near Hohoe. Our friendly guide explained that it is locally named *Agumatsa waterfalls*, which means translated “move”, and “allow me to flow”. The green and biodiverse forest on our one-hour hike to the waterfall and the many bats startling from our bath under the waterfall made us all pause for a moment in great admiration of nature. Apart from the first consciously perceived coffee plants, we discovered bamboo on our way. The bamboo plant grows like palm trees without a secondary growth and are the fastest biomass producers in the world with less than one year of growth. It is especially useful for construction (i.a. scaffolds) thanks to its great strength compared to its biomass, and for waterpipes. We made it back to the bus just before a thunderstorm hit and we ended our day with fresh Kenkey and local spinach at the hotel.

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LOUISE TIELKES

After a very pleasant students' night in Tamale we set off after breakfast on the morning of the 13th of March to visit a farm near Tamale. Neither our Professors nor one of the Ghanaian Postdocs have been there yet so we were all excited what to see. We started the supposing short drive, soon passing a landscape dominated by shea trees. Underneath the shea trees there will be planted maize and sorghum as soon as the first rain falls and then after the harvest, the Fulani herdsmen can come with their animals and graze down some of the crop residues whilst fertilizing the land with cow dung. Later on, we will learn more about who the Fulani are, where they live, what role they play in the society and so on but for now we are driving and driving as the "short distance" ended up to take around three hours.

"Modern" farm

Finally, having arrived at the farm, most of us were not only disappointed but rather shocked. We were greeted by a friendly group of about 10 men who are paid by the owner to look after the farm. It was built 3 years ago by a person who is native to the village but has been living in Accra for 8 years and wanted to do something nice for his village or as Kudir told us – invest his money so no one can ask you for some if you've got it sitting in the normal bank. The farm is a fenced area of about 6 ha with some concrete sheds for animals.

The farm does look okay so far ignoring the fact that the sheds for the ruminants are empty, with neither fodder nor water troughs. The shocking part was looking at the state some of the animals were in. We could see four pretty skinny horses which are kept for races and to teach students how to ride. Most of the sheds were packed with different varieties of poultry: Guinea fowl, peacocks, geese and pigeons. They didn't look too well either but at least had sort of enough space. These animals are kept for showing to visitors. So is the very, very poor and unhealthy-looking camel which will most likely soon die as his fellow did a few days ago. Prof. Schlecht told us that the camel is out of his natural area. Here it is way too humid for it and it can easily suffer from parasites, sleeping sickness, plus there is neither enough fodder nor water – the fat in hump was already completely metabolized.

The caretakers told us that water as well as veterinary care is very poor in this area so they can't do much about the status some of the animals are in.

The main part of the farm is made out of 200-300 cattle, 50 sheep and 75 goats which we sadly didn't see as these are taken out by a Fulani herdsman every day to graze them on common land. The Fulani get paid about 1500 GHS per month for looking after the animals. The value of a single cow is much higher than the monthly wage. The cows are sold to Tamale (alive) where they bring in 3000 - 7000 GHS depending on quality and size. That's why they are often revered to as walking money.



Poor looking camel on farm "near" Tamale

Fulani pastoralists

1. Near Tamale (Ghana)



White Fulani cattle

On our way back from the farm we saw a big herd of mainly white Fulani cows on the roadside so we stopped and talked to one of the herders. He was a 14-year-old boy who has been a herder for 3 years now, mainly during the dry season. Starting to herd animals at a young age is very common in many Pastoralist societies.

Fulani (Ghana), Fula, Fulbe or Peul (Benin) is an ethnic group in the Sahel and many semi-arid parts of West Africa. There is an estimate of about 45 – 50 million people worldwide who are Fulani. They are the biggest pastoralist

community in the world, most of them being semi-sedentary people. Their primary occupation is raising livestock - in particular cattle. The wealth and riches of a herdsman is often measured by the size of the cattle herd. Female cows are rarely sold, only young steers. They make money by selling small ruminants and dairy products such as milk or the traditional *wagashi cheese* (we saw some ladies selling it on the road in Dassa; Benin). These herdsman have several species of cattle, but the zebu cattle is the most common one in West Africa due to its drought-resistant. The dwarf Ndama cattle is commonly herded in wetter areas as a result of their resistance to trypanosomiasis (sleeping sickness) and other conditions directly associated with high humidity. As an ethnic group the Fulani are bound together by the Fula language (Fulfulde), their history and their culture. More than 99 % of the Fulani are Muslims. Even though they are the biggest pastoralist community they are a minority group in most of the countries they live in.

Prof. Schlecht told us that most Governments don't like the Fulani pastoralist as they move around most of the time and cross borders without control so the governments can't control them. That's why they try to put an end to the nomadic lifestyle by for example telling they are part of the terrorist groups attacking villages. Also the governments give more rights to settled farmers than the transhumant pastoralist, leasing them land to set up farms and therethrough block ancient "cattle roads" on which the Fulani used to move from dry- to rainy season pastures for centuries which of course than causes conflicts.



Traditional male Fulani beauty contest

A pastoral Fulani family is the traditional herding unit where tasks are divided by gender and age. The main work of men and young boys is to manage the herd, find grazing sites and set up tents and camps. The women and girls take on the so called traditional female gender roles such as sourcing food, milking the cows, making cheese, taking care of the children as well as weaving and mat-making. The traditional clothing of the Fulani consists of colorful, flowing robes. Typical for the women are henna paintings on their faces. The men wear the typical turbans and face veils. The cone-shaped straw hat, which is still worn in some places, is also typical.

Asking the young herder who we met about life as a herdsboy, he said it is very hard work as there is little pasture during the dry season and they have to walk very long distances each day. The cows don't belong to him or his family but to many different people who pay him / his family to take care. These people – often rich people / politicians use the cows as a living bank so their wealth can't be traced. The boy we talked to walked together with two other boys. They mixed their herds but they can

identify each and every cow so at the end of the day they separate them again. The herd was made up of 300 – 400 good looking, mainly white Fulani cattle which is a subspecies of the Zebu cattle and a good beef breed. During the dry season the clan the boy belongs to is staying in one place for 1 – 4 month and they young men are responsible for taking the cattle out to graze. During the rainy season the older men do this job the boy told us as it is more difficult and they will move the whole community every second or third day. When in the rainy season always 2-3 herdsmen walk their animals together with 2-3 scouts who will go in front and see where to go to.

2. In WeWe (Benin; 15.03.2023)

After a full day's drive from Tamale in Ghana to Djougou in Benin yesterday, we were up early again to visit a small town called WeWe which was a 30 minutes' drive. In WeWe we met the chief's son who gave us a tour to several different sites (as you can read in another day-report). In one of the stops we visited a permanently settled Fulani or as they are called in Benin – Peul group. The village was made up of the traditional beautiful domed houses known as a *bukkaru* or *suudu hudo*, literally meaning "grass house".

These mobile houses are very easy to set up and dismantle, as typical of houses from nomadic societies. They also had a concrete building which we learned is the village mosque as this Peul community was of Muslim faith. They originally came from Nigeria, where they had been arrested for which ever reason. After their release they found refuge in this forest 6 years ago. The village / clan consists of about 100 families with a total of 1500 people. Even though they are settled in this area for a long time, marriage only takes place within the clan. Neither this Peul clan nor the other ethnic groups around want to mix. Since they are settled, they don't move during the



Grass houses of the Peul village in WeWe

rainy season which often causes arguments between the farmers of WeWe and the Peul herders the chief's son explained to us. The farmers see it as unfair that the Peul are using common grass for their animals whilst the farmers have to buy / lease land. Nowadays the Peul not only have to pay a certain amount a year for the land the village is built on but also for grazing rights. Whilst our visit we saw many old men under trees and many women taking care of the kids. The village eldest told us that most kids go to school in WeWe but just randomly as they also have to help at home.

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Images: 1,2,4,5 – taken by me

Image 3: <https://i.pinimg.com/564x/8b/bd/3c/8bbd3c60f3ed95ded1b9d67b8c14fb5e.jpg>



eldest, many kids, the chief's son and another man

13., 14. AND 15.03.23: SHEA AGROFORESTRY SYSTEMS AND CHARCOAL PRODUCTION

MARÍA MORALES

On the 13th we had a short stop on a shea plantation. Shea trees (*Vitellaria paradoxa*), also known as karité trees, are native to the Sudano-Sahel region of West Africa. In Ghana, they are often found in parklands (agroforestry systems), where they grow among crop fields characterized by maize, sorghum, and mainly yam. According to the Ghanaians that own that land, they do not plant the shea trees but just let them regenerate naturally in the area.



Ghanaian land owners sharing their experience with shea tree parklands

After 8 years, shea trees produce small round fruits that are harvested in the mid-rainy season, around July to September. Inside the fruit, there is a kernel that looks like a chestnut, which is full of fat. These kernels are roasted and melted in an energy-intensive process to obtain shea butter. This product is locally used for cooking; however, it has also gained a lot of popularity in the cosmetics industry, increasing its demand on a worldwide scale. In Ghana, in particular, it was the third most important cash crop in 2006. The community that owns the parkland that we visited extracts about 30-40 kg of kernels, which are sold to a processor in Tamale to produce the butter.

Transfer from Ghana to Benin through Togo

On the 14th of March, we started the day very early in the morning and drove all the way to the border between Ghana and Togo. There we waited for the officers to issue an entry visa for each one of us. Once inside Togo, we stopped in Kara to have lunch. There you could already notice some cultural differences such as the language since there, people speak French and not English as it is in Ghana. We continued our way toward Benin, where we stopped at Djougou where we spent the night.



Transit stamp from the Togolese border

Local charcoal production in Benin

On the 15th of March, we moved to an area near Parakou in Benin, where we met a community, whose chief owns an extension of 15 km² of non-classified, or unprotected, forest. The community extracts timber from the forest and uses big, good-quality trees, such as *Khaya senegalensis*, to make furniture.



Timber extracted from the non-classified forest.

The lower-quality trees extracted from the forest are cut down to produce charcoal. The process consists in making a mound of the wood pieces of these trees, heating it, and covering it with sand. This creates combustion under anoxic conditions which results in the production of charcoal. They produce around 80 sacks of charcoal each month, which are commonly sold for around 4,000 CFA per sack to traders that will bring them later to Cotonou where

the price increases up to 7,000 CFA per sack. The income obtained is collected by the chief and used later for the benefit of common needs in the community.



Sacks of charcoal ready to be sold.

Every year, on the 1st of June, they plant trees in the forest. This corresponds to an action promoted by the National Law of the Beninese State. Other than that, there is no current plan for the sustainable management of the forest. It is important to mention that even though the forest that the community owns it is non-classified, they do have to pay a ticket to the environmental authorities to be able to extract wood.

Cashew plantations in Benin

As an additional input in this stop, we discussed about cashew plantations in Benin and their importance for the local economy. Cashews thrive in around 20 western and eastern African nations, from which Benin is one of the main producers. About 90% of the raw cashew nuts that are traded around the world come from Africa.

On the land owned by the community, there were also some cashew trees with cashew apples ready to be harvested. The community members that were guiding us mentioned that they can harvest up to 350 kg of cashew apples per tree. After the harvest, they take the seed and roast it to separate the shell from the cashew nuts, which are later sold in the local market. The cashew apples are not used and are just discarded instead.

Pond from a former quarry in Benin

Finally, as part of the visit to this same community, we moved to an artificial pond used by the community. Originally, in this area, there was a quarry from which granite and gravel were extracted for road construction. While digging there, they came to an underground water source by accident, which filled up the quarry. The village asked to keep the pond open and full of water, and nowadays it is used for washing clothes and water consumption by animals, not humans.



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Bokoussera



Handing the drone picture of the village to the local community

When we arrived at the village, we first handed off a gift to the village elders. A high-resolution drone picture of the village from above. This was our door-opener to the local community, bringing a new perspective and something everyone could quickly relate to and talk about.

Afterwards we got a tour around the village where our guides shortly introduced us to the different research projects carried out on site. Right now, different research and PhD projects are running in Bokoussera assessing different aspects of the local agroforestry system.

Agroforestry systems are of great interest as they are traditional systems for production of goods but also important reservoirs of biodiversity. Moreover, the Fulani ethnic group is traditionally a community of mobile herders, moving their cattle across country borders according to the seasonal rainfalls. Therefore, the village of sedentary Fulani is especially interesting for researchers.



Cattle of the traditional Fulani breed moves around the village

Micronutrient dynamics in West Africa

The first PhD programme explores the dynamics of micronutrients. Chike, the PhD student from Nigeria, is studying how micronutrients travel from rocks to soil and through plants to animals and humans. This research is important to combat malnutrition at different levels. After all, when nutrients are missing or unavailable in the soil, they are also unavailable for human consumption, which can lead to hidden hunger and related health problems. The combination of gamma spectroscopy, local soil designations and knowledge about the soils enabled a rough classification of local soils into different types:

- 1) Lowland swamps, used for rice production.
- 2) Upland soils, used for millet, sorghum, yam and maize production.

Analysis and mapping of the local agroforestry system

The second PhD programme analyses the local agroforestry system. The animals are moved within the system depending on the rainy season. In the dry months, they are moved to the south and just before the rainy season starts, they are moved back to the north. The animals are herded along corridors by the herders who own the land and the cashew plantations. The impact of the herds on the land cover and vegetation is measured by analysing, cutting, weighing, and drying the above-ground herbaceous biomass. Manure is collected to quantify and analyse it. Livestock productivity is measured by milk production.

Land cover change will be studied using satellite imagery from different years since 1990 and GIS remote sensing focusing on cashew systems and water bodies. These data will be combined with

surveys of local farmers. Yields and fertilisers will also be compared, and the carbon sequestration of cashew plantations and agroforestry systems compared to secondary forests will be investigated.

Socio-cultural aspects of the agroforestry system

The third research project deals analyses land tenure in Bokoussera. Five hundred people in the community were interviewed and detailed qualitative information was collected in the form of biographies. appeared that the land tenure system in Bokoussera is based on communal land use rights. They start with the family unit. The families own land, which is then available to the community. Normally, the land is not sold, but inherited or gifted to others. However, it is also possible to talk to the leaders to obtain land use rights. As the community is Christian, it attaches great importance to the education of its children. All children go to primary school and many to secondary school.



The local agroforestry system characterised by cashew trees

Bokoussera – an innovative village

In general, the motivation to innovate is high in the community. They have developed new products such as cashew fruit juice and different forms of traditional *waghashi* cheese, which they market locally and regionally. Traditional *waghashi* cheese, for example, has a short shelf life, but by using different coagulants and even soy milk, its shelf life has been significantly extended. This allows access to markets in an environment with poor infrastructure and limited transport and refrigeration options. Generating additional income to their subsistence farming, improving products, and adding value to them.

Cashew-fruit juice - an example of an innovative product



Granite mining

On the way back to the hotel we stopped at a granite mine near Parakou. In contrast to the mines we know from Europe, the granite mine in Benin is a so-called quarry, an open extraction site of surface rock material. The granite is mainly used for road and construction building. Therefore, it is shattered into smaller rocks on site.

After asking permission to enter the site, we walked around and talked to some of the people working there, asking questions about their work. They told us that they burn wood on the granite rock to heat the stone and then shock it with cold water to break it. Working conditions in the quarry are tough. The ambient temperature is 37°Celsius in the shade and even hotter in the sun. Add to that the heat of the fires and the fact that the workers often must pay for the wood themselves. However, we noticed that many women work in the granite mine. Most of the women and other people who work there are simple labourers who work for others and earn about 6.5 € per day, only part of what their bosses get.



Although the extraction of raw materials such as mining does not appear to be sustainable at first glance, it is a good way for local people to get quick money on a daily basis. Moreover, the value of the granite rock for the ecosystem is comparatively low, as little to no vegetation would grow on it. After all, it is a relatively small area, but the thickness of the rock can create a lot of value on it.

Granite mine with several fires to heat the rock

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SATURDAY, 18.03. 23 A.M.: THE ROYAL PALACES OF ABOMEY

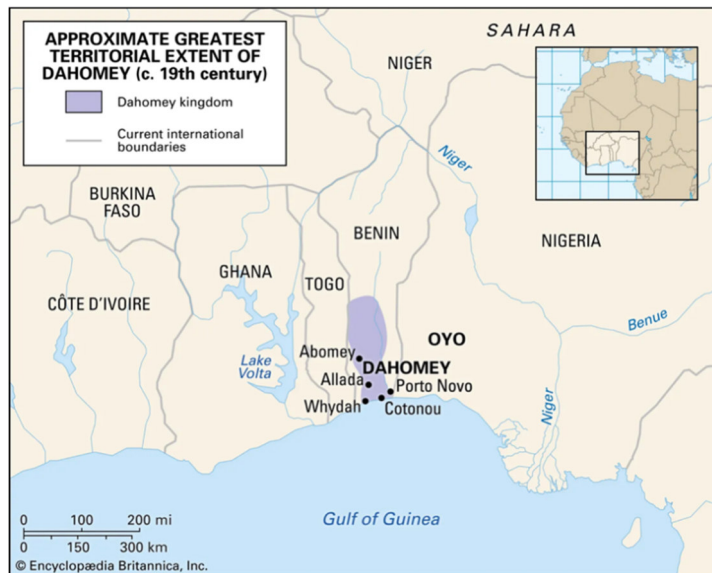
VIVIANE K. ECKHARDT

On Friday 17 March, we travelled around 300 km from Parakou to Abomey in the southern part of Benin. We had a long day on our busses where we got impressions of uranium road transports from Niger to Cotonou and experienced our first and only traffic jam during the excursion. Our original plan was to visit the Historical Museum of Abomey and to have a guided tour there. But our trip took longer than planned. As we arrived at the Royal Palaces there was only time to discover the small market with different crafts like jewelry, hammocks, or small statues. Luckily, the people from the museum offered us to open early on Saturday morning to give us a tour at the museum which enabled us to maintain our program without leaving anything out on these final days of the excursion.

Hence, on Saturday morning the museum was our first stop on our way to Porto-Novo. This is what I took away from the guide's explanations on the history of the Kingdom of Dahomey and its palaces in Abomey plus additional information from online research on this topic.

Kingdom of Dahomey

The Royal Palaces of Abomey were the center of the kingdom of Abomey, which was established in 1625 and lasted until 1900 (UNESCO, 2023). During this time twelve different kings ruled over the kingdom, and some increased its dimension in a significant way which eventually made it an important regional power. In its early days the kingdom, had only power in the Abomey plateau. However, towns in a broader radius were taken over soon. This was only possible due to the kingdom's military strength which was of critical importance for its further development. A well-known part of Dahomey's military organization were the famous women warriors, often called Amazons. Due to military actions, especially the Southern borders of Dahomey expanded to the Atlantic Ocean in the early 18th century. Getting access to the sea was the major factor to get engaged in slave trade with the Portuguese, Dutch, and British and to gain substantial economic power. People from the conquered towns either served the king as slaves or were sold as such, especially to European or Arabian slave traders.



Approximate greatest territorial extent of Dahomey, 19th century. Source: Encyclopædia Britannica

The relationship between the king and slave traders can be reflected in the example of the Brazilian slave trader Francisco Félix de Sousa who became viceroy of the kingdom under King Ghezo in the 19th century. He provided military and financial support for Dahomey and his descendants are still active in politics of the present Benin (Black History Month, 2019). During our tour the guide often referred to “Portuguese friends” of the kingdom.

As Great Britain was a relevant partner in slave trading, the British ban of slave trade in the 1830s had significant influence on the kingdom’s economy and politics. Because King Ghezo and influential figures like de Sousa were not ready to accept the new situation,

the British blockaded Dahomey’s ports in 1851 and 1852. After internal political conflicts the kingdom finally stopped its engagement in slave trade. Since then, palm oil trade gained more economic relevance (Black History Month, 2019).

In the late 19th century, the French increased their influence in the region, especially in the coastal cities of Cotonou and Porto-Novo. From 1892 to 1894 the French-Dahomean war took place in which Dahomey’s women warriors also played a crucial role. As the French were superior, they reached out for influence in the administrative and political issues of the kingdom. In 1900 they dethroned the king of that time and ended the kingdom. According to Bay (1998: 278 ff.) European colonial powers justified their imperial intentions in (West) African regions with their perceptions about the local traditions and labelling the people of Dahomey amongst others as “uncivilized”. E.g., the exhibition of female warriors in the zoological gardens of Paris were an expression of this (ibid.).

Royal palaces of Abomey

No accurate date of the construction of the palaces are available but according to Black History Month (2019) the palaces were built during the rise of the kingdom in the early 17th century. In total there are ten palaces on 47 ha, organized in two different sites (UNESCO, 2023). This is due to one king, Akaba, who built his palace separated to the one of his father. Both sites are organized in a similar structure and are bordered by cob walls. Originally, the roofs of the buildings were built out of straw but due to natural disaster they were rebuilt with roof tiles.

The palaces are built around three types of courtyards with rising importance: the outer, the inner and the private one. Each court is separated by an extra entrance. The first or outer court was a working- and a marketplace. Guests also were received in the outer court. For special visitors of the king, there was a guest room. To get to the second or inner court as a visitor, ministers of the king decided whether the visitor’s concerns were important enough to let the person in and meet the king.

In the second court, there are also spiritual rooms. In the court that is part of the museum, there is the spiritual room of King Aklele. This temple was built after the death of the king as a place for his spirit to come and to rest. According to the guide, the blood of 41 slaves, the blood of animals, palm oil, canon powder and sea water were given as sacrifices. The king’s belongings and a part of each natural element were brought to the room. No one is allowed to enter it except of virgin and menopause women to bring energy to the king and to feel the spirit. In 1894, the last of such temples was built at the palaces, but without the sacrifice of human blood as this practice had been banned before.



One of the palaces with symbols of the kings. Source: CRAterre Ensag

At the palaces everyone must take out their shoes, so did we while visiting the museum. Only the king is allowed to leave them on.

Organization of the kingdom

The society was organized in a monarchy with the king as the head supported by several administrative structures, in which women, especially the king's wives, also were involved (Bay, 1998: 8). A king was chosen by the former king amongst his sons. As the guide told us, it was also possible to ask an oracle if the former king did not decide on a new one before his death. Every king had around five to ten wives and took over the ones of the former king. Bay (1998: 8) describes that the kings' wives were of different social origins and not necessarily with royal background. According to the museum's guide, a wife was chosen in respect to her beauty.

There were three different social classes at the court. The royal family itself made up the first. People doing craft activities like blacksmiths, sculpturers and artists built the

second class, followed by slaves. The differences between the three classes were visible through their clothing: people belonging to the royal family wore colorful fabrics in different ways related to their position, e.g., a princess wore it over her breast, the king over his shoulder. Membership of a class was not rigid; it was possible to move between the second and third class. Individuals living in the villages of the kingdom usually made weapons or artwork.

Museum and UNESCO World Heritage

The Royal Palaces are UNESCO World Heritage since 1985. Today, there is still a king from the royal family for traditional reasons. He only represents the Abomey area and does not live at the palace. As the museum only occupies two of the palaces the remaining area is used for rituals, ceremonies held by the present king as well as for traditional activities like dancing. The king also gives advice to people visiting him. Besides of practicing the traditions at the palaces he works as a businessman. The entrance fees of the museum are not intended for his or the royal family's benefit, as the guide told us.

The museum hosts a lot of exhibits testifying to the culture and customs of the kingdom. Weapons and war trophies are displayed as well as spiritual objects. In addition to the original exhibits there are documents like photographs or articles of historical European newspapers reporting about the kingdom from a colonial perspective. Especially in displayed cultural objects the characteristics of the kingdom appear to be well represented. In the arming room in the second court one can get impressions of the importance of warfare, as there are different weapons as well as memorials for fallen warriors exhibited. A painting shows the history of the women warriors of the kingdom. Other objects are related to the spiritual beliefs, e.g., we were told that they are hosting the spirit of the decedents.

The front of the meeting room, which is also situated in the second court, shows the symbols of various kings. King Ghezo's throne, built on four enemies' scalps, is displayed inside, and symbolizes the power of the king. For the ritual of choosing a new king there is a special chair, also displayed in this room and the King's stick for representation, which can also be used by other persons to represent the king. In cabinets there are scalps of enemies defeated in battles, the kings' jewellery, gifts from Europeans and the hunting stick of the king, with which, according to the story, he only had to touch the animals, so they died. In this room there are also primary sources about collaboration in slave trading with

European and Arab countries and about French colonialism exposed. Especially in the European press Dahomey was presented as a place of barbarism and uncivilized life and especially the women soldiers were exoticized.

The visit of the museum gives unique insights in the reality of this ancient powerful kingdom in West Africa. For me, the multitude of original spiritual objects exhibited in an environment where they directly belong to and to get information by a local guide was a fascinating experience. It offered me new insights on Benin's and West Africa's history. However, out of my perspective a critical presentation of the involvement in domestic and international slave trade was entirely missing.

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SATURDAY, 18.03.23 P.M.: VISIT TO TWO SMALL RUMINANT BREEDING FARMS IN ABOMEY

NIPUNA WITHANAGE

Small ruminant breeding in Bohicon

After visiting the Abomey Royal Palace, we headed back to Bohicon, where we visited a farmer who



Small ruminant keeping in urban area

raises small ruminants in a traditional way in the urban area. The farm had goats and sheep of different sizes and ages. The farmer primarily raises West African Dwarf (WAD) goats, also known as Djallonké in French, and male Sahelian goats for crossbreeding with the local dwarf breed, as the dwarf breed is trypanotolerant.

WAD goats are spread across the coastal West and Central Africa, ranging from Senegal to Congo. It is believed that their characteristic dwarf trait may have evolved because of the humid forests of the area where they originated (Wilson, 1991). Another characteristic trait of the WAD breeds is their tolerance to trypanosomiasis or sleeping sickness. This disease is caused by *Trypanosoma* sp., a unicellular parasitic protozoa, infecting the blood of the host causing fever, weakness, and weight loss. It is fatal unless treated and is transmitted by tsetse flies (World Health Organization 2022). WAD breeds are not affected by the sleeping sickness, although they can carry the parasite but do not show symptoms of the

disease. The F1 cross of the Sahelian breed crossed with the dwarf breed is also trypanotolerant. However, with continuous back-crossing of F1 and F2, the tolerance is reduced unless it is again back-crossed with the dwarf breed, as only the dwarf breed gene transmits the tolerance.

The farmer we visited had a few objectives for crossbreeding the Sahelian type with local dwarf goats. The genetic trait of trypanotolerance of dwarf goats is important to have a healthy flock of animals without the sleeping sickness in the humid region. By crossing with the dwarf breed, the farmer is able to achieve this important genetic advantage. However, the market prefers larger carcasses of animals for meat. The Sahelian type of goats is rather larger in body size, and therefore, by crossing with the Sahelian type, the farmer can get crossbreeds larger than the local dwarf type, which are also tolerant to sleeping sickness. Another objective is the rapid growth rate of the crossbreed and higher reproduction rates. Crossbred females can produce three offspring while the local type can only give two offspring at one time. The farmer does not practice community-based breeding because objectives of each breeder can differ as they have difficulties in deciding which strategies to follow as a common decision. However, they exchange rams and bucks for breeding the ewe and doe (female sheep and goats) among the breeders. The animals feed on natural pasture found around the neighbourhood as it is expensive to buy feed. They go to pasture without a herder and return after a few hours. Other than goats, the farmer also had local breed sheep in their herd.

The “Violet de Galmi” onion – an innovation in the Sahel

We came across trucks carrying a large amount of onions through Benin. The popular *Violet de Galmi* onion comes from a village called Galmi, 500 km east of Niamey in Niger, and it is an example of innovation and international trade in the Sahel. Farmers in Galmi breed this onion type further, and it has spread throughout the region because it is suited for rural resource-poor areas where farmers need little investment to start with. It is an off-seasonal crop that farmers can grow during the time that they are less busy instead of migrating for work to other regions. Therefore, it has both economic and social importance in the rural Sahel. It can grow in arid conditions expanding even into the Sahara region under irrigation conditions. Since it grows in arid conditions, onion has no major fungal problems and that is one advantage of growth under phytosanitary healthy conditions. If the onion is properly aerated, it is possible to transport it over long distances without special conditions like cooling.



Onions for sale along a street in Bohicon, Benin

Model farm visit in Djidja



Impressions from the model farm in Djidja

During our visit, we had the opportunity to explore a model farm situated near Djidja between Dan and Setto. The farmers in charge of the farm had studied Bachelor's in Science degrees from the University, which made their animal breeding processes more systematic. The farm housed a wide range of animals, including chickens, turkeys, guinea fowls, sheep, and goats. The Sahelian breed of sheep, known as "Uda," was particularly interesting, with its larger heads and different coat colours and ear shapes compared to the local dwarf type. The Uda rams had horns, and the ewes were usually polled (African Breeds of Livestock - Oklahoma State University 2022). The farmers had a different breeding objective from the previous urban farmer, as they aimed to import large breeds from the Sahelian region and raise and sell them in the regional market.

The farm had been operational for five years, and the farmers were considering expanding near the main road to reach a larger customer market, as their current location was far inside with less traffic. They were also considering enhancing the value chain of cassava by processing it into "gari", a popular West African food. Additionally, the farmers grew maize, cassava, soybean feed, rice, and oil palm residue fodder for animals. The farm had a rainwater collection system on the roof and a collection tank, which was essential for crop cultivation during the dry season and providing water for the animals.

Adjacent to the model farm was a large cotton field. Cotton is a perennial crop that is not resistant to stagnant water, and its quality often depends on the potassium levels in the soil. The government had set a fixed price for cotton, currently (2023) at 300 CFA per kilogram. The cotton was handpicked, and the seeds were separated from the fibres through a process called ginning. There were government structures in place to pick up the cotton, and the farmers had little risk due to the assured income. However, environmental risks were frequent due to frequent droughts and diseases. Instead of burning the cotton residue, the farmers used it for composting. Cotton production was labour-intensive, with manual processes for everything, including land preparation, as animals were not used for this purpose. While tractors were used in the north, they were not as common in the south.

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SUNDAY, 19.03.23: PORTO NOVO AND THE PILE DWELLINGS

NICOLAS EHRHARDT

After the successfully completed oral exams for the excursion in the early morning and a joint breakfast, the last programme day of the excursion was unfortunately already announced. We started with a walk through the hotel grounds of the Centre Songhai in Porto Novo (an agro-ecological research and training centre with comfortable accommodation for researchers), where we could once again put our knowledge of various native and non-native animal species to the test. In (very) small enclosures, donkeys, bouquets, horses and the Dahomey dwarf cattle could be observed to build on knowledge about small breeds and their advantages (e.g. tolerance to sleeping sickness). Opposite the enclosures, various mini-plantations had been established, such as of Moringa (*Moringa oleifera*). Moringa has received more attention in recent years due to its various useful properties as a food supplement (very rich in vitamins, proteins, minerals, β -carotene), as a medicinal plant (including anti-rheumatic, anti-inflammatory, bactericidal effects) and other possible socio-economic applications (for water purification, animal feed, or oil production for culinary or other uses) (Gupta et al. 2018).

Afterwards, a short bus ride took us to the historic centre of Porto Novo. Porto Novo is located in the south-east of Benin on the edge of a coastal lagoon, which was pleasant to look at during the bus ride. The town got its name from Portuguese traders/colonists (Porto Novo - (*port.*) New Port) and was probably founded in the 16th century, flourishing mainly due to the slave trade of the following centuries (Lotha 2019). Today, Porto Novo is also the administrative capital of Benin. In contrast to other cities on the excursion, Porto Novo made a more well-kept impression, at least subjectively, with the housing structure appearing more spread out outside the historic centre, so that a fresher sea breeze remained noticeable in the warm, humid air. Like many larger cities on the west coast of Africa, Porto Novo is a melting pot of religions and cultures, between early African Islam, voodoo and fetishism, colonised Christianity and modern capitalism. After visiting a small old mosque in the city centre and the modern Christian cathedral not far away, one could at least see some voodoo stalls in a segregated area of the market. The larger Magic Market was unfortunately not open on the day of our trip. As far as one could tell from the voodoo stalls that were present, however, they were not selling magic hand puppets, but rather a mixture of plant and root medicines, traditional instruments and other natural artefacts such as animal body parts.

To get an insight into the diverse urban structure, the following pictures can be viewed: On the left, a street scene with Arabic murals; on the right, a French post office dating from the colonial era.



Street scene with Arab mural (left), colonial French post office (right).

As already described, Porto Novo flourished especially due to the slave trade. To learn more about the history, the next destination of the excursion was the "Black African Pantheon", a private museum commemorating the oppression of Africans. As a symbolic motto for the exhibition, the museum chose a quote (1802) by Toussain Louverture: "In overthrowing me... you have only cut down the trunk of the Negros's Tree of Liberty. It will spring up again from the roots which are countless and deep."

Toussain Louverture was a fighter of the first "Black Republic" in history in the former French colony of Saint-Dominique (Haiti), who used the circumstances of the French Revolution and its change in values to fight for a constitution for Haiti (Baykal 2021). With the reintroduction of slavery in France by Napoleon Bonaparte, a French force also landed on Saint-Dominique and Louverture ended up in a French prison as a fighter for black independence (*ibid.*).

The museum in Benin honoured the heroes and martyrs of people originating from Africa, using the symbolism of shared rooting and the "common heritage of enslavement". The tree from Africa and Madagascar, as an icon of the museum, is meant to symbolise the cohesion of Africans, who are deeply rooted despite Africa's divided nature. The unity here comes from the pain of slavery and that the ways of Africa offer hope for a better future despite all the suffering. The small leaves on the tree branches symbolise the present generations that can flourish again despite their past.



Besides from this symbolic tree monument, the rest of the small museum consisted of a more or less random collage of important black people: such as the aforementioned Toussaint Louverture, the founder of the first free black republic; or the museum's founder: Karim Urbain da Silva together with portraits of his ancestors. The portraits on display ranged from the South African leader Shaka Zulu and Ménélik the 2nd (Emperor of Ethiopia) in early modern times to Michael Jackson and Bob Marley in modern times. Also present as a portrait was the Ghanaian Wilhelm Anton Amo, who will be discussed in more detail for academic interest. Amo was, for a long time (in the 1730s), the first Afro-German academic. As a Doctor of Philosophy, Amo studied the rationalism in the currents of Enlightenment at the universities of Halle and Jena and wrote about black rights in Europe (Mabe 2017). Decades before the first movements to abolish slavery in Europe, Amo, who came to Europe as a commodity and "chamber ear", disputed the then prevailing Scientific Rationality of oppressing Black people as objectively inferior human beings and the double standards in this thinking (*ibid.*). Although Amo was forgotten and only rediscovered in 1916 by a librarian from Halle (*ibid.*), he perhaps also contributed with his work of his time to the ideas and critical debate that later heralded the end of slavery in Europe.

Unfortunately, the museum was not subject to a systematic or historical classification/reappraisal. However, the history of Benin also has an exciting dynamic, even if it is not as simple a narrative as that of Haiti with Louverture and its fight for independence and freedom. In the 18th century, the African kingdom of Dahomey conquered large parts of the coast (Gulf of Benin), not least through a highly qualified standing army, which also included a female contingent (called "Amazons" by the Europeans) and established itself as the dominant power on what was then called the "Slave Coast" (Adotevi 2023). Dahomey was an important supplier of slaves for the transatlantic trade (the supply to European demand) (*ibid.*). In 1852, however, the then King of Dahomey was forced by a British naval blockade to accept a treaty abolishing the slave trade, also as a result of the abolitionist movements in Europe (*ibid.*). At the end of the 19th century, Dahomey was gradually colonised by France, and not quite 100 years later was released into independence (*ibid.*). In post-colonial history, the fragmented national movement and political unrest led to no less than six successful military coups, including the renaming of Dahomey as the People's Republic of Benin under the ideology of a Marxist-Leninist regime and a democratisation in the 1990s with the renaming of Benin as it is called today (*ibid.*).

To follow the traces of this dynamic history, another excursion was made in the afternoon to the pile-dwelling settlement of Ganvié on the edge of the lagoon near Porto Novo. At the time of the slave trade, the expansion of the African kingdom of Dahomey was based on raiding surrounding villages and regions and plundering them for the slave trade (*ibid.*). In order to escape this plundering and enslavement, a settlement was built on the water in the 18th century, as Dahomey's warriors traditionally did not go into the water (according to the tour guide's story). With larger wooden boats and local guides, we travelled through rivers and canals through the green lagoon to the pile-dwelling settlement, admiring domestic birds sitting on poles at the sides of canal during the drive. Today, most of the inhabitants live from fishing in the lagoon, as could be seen from the many small fishing canoes but also from the many staked aquacultures. However, tourism also plays a major role, and several stops on the tour were specially designed for tourists, including shopping facilities for souvenirs. The settlement as a whole consisted of a collection of more or less stable-looking huts built entirely on wooden stilts, or some on concrete. Besides the classic huts, there was also a mosque, a school and a few larger buildings on stilts for the more than 30,000 inhabitants. One very fascinating sight was the supply of drinking water. Since the houses have no pipe connection, you could see a small shack with a guy holding a tank hose and fulfilling the with barrels and containers fulfilled canoes. The settlement as a whole was embedded in the opening lagoon on one side and a marshy biotope on the other. All residents moved with wooden canoes through the sometimes narrow, sometimes wide channels between the houses, which was a fascinating sight. This pleasant mixture of nature, fascinating settlement structure and insight into regional life provided a perfect conclusion to the excursion.



Fishing net thrown by a child in Ganvié village

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