Culture Unbound
Journal of Current Cultural Research

Mobile Application to Secure Tenure in Rural Tanzania: Anticipating Diverging Agricultural Futures and the Production of (In)securities in the Kilombero Valley

By
Astrid Matejcek and Julia Verne

Abstract

In light of climate change, projected population growth, increasing conflicts over land and the question of food security, the Tanzanian government takes the respective visions of environmental futures as a cause and justification for particular measures in the here and now. One such modality through which agricultural futures in the Kilombero Valley are currently made present and decided upon is the use of the Mobile Application to Secure Tenure (MAST). Through the use of this application, on the one hand, a more capital-friendly land legislation should be developed. On the other hand, by issuing Certificates of Customary Rights of Occupancy (CCROs), which are supposed to offer a certain security to current land users, expected conflicts are sought to be reduced and prevented. Thus, by examining the use of MAST and the particular ways in which it renders possible futures actionable, this article contributes to ongoing research that aims to illustrate how "humans [...] do not own and shape 'their' future alone" (Granjou et al. 2017: 8). While such technologies are generally developed and employed to increase certainty, following the implementation and effects of MAST, in particular, we will show how the specific materiality of this mobile application not only allows to secure tenure, but, at the same time, creates new insecurities that contribute to the complex emergence of environmental futures in this part of rural Tanzania.

Keywords: environmental futures, (in)security, anticipation, mapping narratives, land (in)formalization, mobile applications, SAGCOT, human-technology-nature relations

Matejcek, Astrid & Verne, Julia: "Mobile Applications to Secure Tenure in Rural Tanzania: Anticipating Diverging Agricultural Futures and the Production of (In)securities in the Kilombero Valley", *Culture Unbound*, Volume 13, issue 3, 2021. Published by Linköping University Electronic Press: http://www.cultureunbound.ep.liu.se

Introduction

Uncertain environmental futures, projected population growth and the question of food security have come to shape the visions for African agriculture in a particular way. Considered as "Africa's sleeping giant" ten years ago in a World Bank report discussing the prospects for commercial agriculture (World Bank 2009), an image of African agriculture as being ready for its awakening through an optimization of inputs and resource use has become prevalent in policy circles (see also World Bank 2013). In Tanzania as well, food crop production has been identified as being far below its potential, leading to efforts by the government as well as by various donors and development agencies to provide a fertile ground for agricultural intensification. Launched in 2010, the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) was meant to serve as a main facilitator in this regard, with the Kilombero Valley being promoted as one of six development clusters at the end of 2018.

Advancing a familiar trope in the land rush context (see e.g., Cotula 2013), the growth corridor concept seeks to incorporate areas with "yield gaps" or "idle" land into modern market relations, potentially based on joint ventures with foreign capital. That this apparently idle land is only very rarely actually "unused" or "asleep", and that land ownership and use is actually highly contested, becomes clear in reports about forced evictions of (agro)-pastoralists and violent conflicts between local peasants and "newcomers" who wish to benefit from attractive farming conditions in the Kilombero Valley (e.g., Nindi et al. 2014). Indeed, as Kimaro (2014) has pointed out, as a result of these political efforts, the demand for agricultural land in Tanzania from both smallholders as well as from commercial farmers and potential investors has never been higher. Fear of severe local conflicts, political instability, resource degradation and other environmental risks thus forms a shadow over these highly optimistic visions for African agricultural landscapes.

Both visions, whether euphoric or fearful, contribute in particular ways to what has been called a "regime of anticipation" (Mackenzie 2013: 391), a state characterized by a thinking and living toward the future (Adams et al. 2009: 246). In this case, particularly politicians, development practitioners, and investors make efforts to create preferred futures by "enacting a future that (hopefully) makes a present that (hopefully) shapes the future" (Wilkie & Michael 2009: 504, see also Anderson 2007). Hence, in anticipatory action, uncertain environmental futures become cause and justification for particular measures in the here and now.

One such modality through which agricultural futures in the Kilombero Valley are currently made present and decided upon is the use of the Mobile Application to Secure Tenure (MAST). Through the use of this application, on the one hand, a more capital-friendly land legislation should be developed. On the other hand, by issuing Certificates of Customary Rights of Occupancy (CCROs), which are

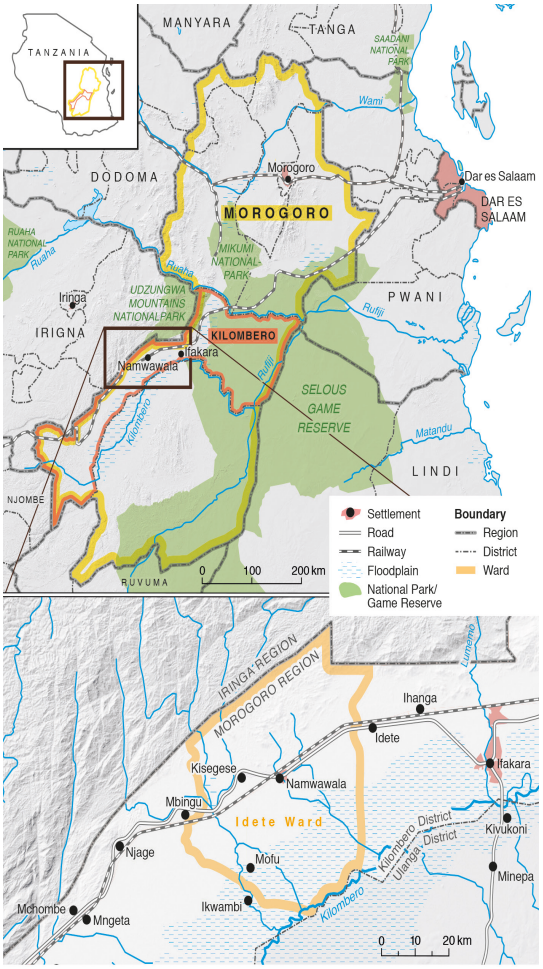
supposed to offer a certain security to current land users, expected conflicts are sought to be reduced and prevented. By examining the use of MAST in the Kilombero Valley in this article, we set to emphasize the notion that "anticipation includes more than acts of representation and their effects on how people perceive future possibilities" (Groves 2017). Focusing on this digital technology and the particular ways in which it renders possible futures actionable, we contribute to ongoing research that aims to illustrate how "humans [...] do not own and shape 'their' future alone" (Granjou et al. 2017: 8). While such technologies are generally developed and employed to increase certainty, following the implementation and effects of MAST, in particular, we will show how the specific materiality of this mobile application not only allows to secure tenure, but at the same time creates new insecurities that contribute to the complex emergence of environmental futures in this part of rural Tanzania.

2. Making Land, Preventing Conflicts: Agricultural (Techno)politics in the Kilombero Valley

Tanzania has a chequered history of agricultural policies and slogans (see e.g., Sulle 2016). Embracing a market-oriented agricultural transformation agenda, the concept of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) has been developed with the aim to facilitate the commercialization of Tanzanian agriculture by tripling the output of food or agrofuel production through private-sector investments. The project's major goal has been stated as to bring 350,000 hectares into profitable production by channeling investments into designated clusters, where large-scale farms and agribusiness players would develop linkages with smallholder farmers through so-called hub and spoke structures (i.e., outgrower schemes and block farming arrangements) (Milder et al. 2012: 2). In order to facilitate this, the government of Tanzania has committed itself to help investors to identify and secure land, to upgrade the road, energy, irrigation, and rail infrastructure along the corridor, as well as to train and organize smallholder farmers. The program has also called for significant regulatory restructuring, e.g., regarding land legislation, to further facilitate the entry of capital into agriculture.

The Kilombero Valley in the South of Tanzania, one of the largest wetlands in Africa, nestled between the Udzungwa Mountains to the Northwest and Selous Game Reserve and Mahenge Highlands to the Southeast, lies at the heart of the sixth cluster promoted by SAGCOT (Fig. 1: Map of Kilombero Valley). For its population, which is supposed to amount to half a million, the wetland has long provided a fertile ground for agriculture, both subsistence farming and the production of cash crops (Beck 1964, Monson 1993, Dinesen 2016). This has also attracted migrants from other parts of Tanzania (Kangalawe & Liwenga 2005:

970). Thus, contrary to being "idle" and waiting to be put to use, agriculture has been extended, especially rice production, to fulfil the needs of an increasing population. Moreover, the arrival of pastoral and agro-pastoral communities has heightened the pressure on land through increasing livestock numbers. This has not only been associated with environmental concerns but also with increasing conflicts over resource use, particularly between farmers and livestock keepers (Kangalawe & Liwenga 2005). Against this background, the Kilombero Valley does not only appear to be a hotspot regarding its economic potential, but also for far-reaching socio-ecological transformation processes and conflict dynamics which have led to calls for legal reforms regarding these land issues.



Cartography: Irene Johannsen; geodata: © OpenStreetMap contributors, Made with Natural Earth, GADM, Jarvis et al. (2008), UNEP-WCMC and IUCN (2021)

Fig. 1: Map of Kilombero Valley

Realising the need to not only identify available land and make it investable, but to also provide the ground to avoid increasingly violent conflicts over land, Tanzania has started a complex and institutionalized land demarcation and valuation process. The CCRO in 2004, the Land Use Planning Act No. 6 of 2007, the Tanzania-G8 Land Transparency Partnership (TLTP) in 2013, and finally the Land Tenure Support Program (LTSP) launched in 2016 have all been targeting the issue of land rights. The last of these programs, the Land Tenure Support Program (LTSP), which officially ended in July 2019, was initiated as a pilot project under the Tanzanian Ministry of Lands, Housing and Human Settlements Development in cooperation with the Department for International Development (DFID), the Danish International Development Agency (DANIDA) and the Swedish International Development Cooperation Agency (SIDA), with the particular aim to develop or find a technology that would make it possible to secure tenure in rural areas of Tanzania.

Hence, building on earlier attempts with similar aims, various ways of mapping, registering, and distributing CCROs have been tried out over the past three years in the Kilombero Valley. Finally, the Land Tenure Assistance (LTA) was able to provide MAST which has recently been tested by the United States Agency for International Development (USAID). This service seeks to combine a participatory approach and on-the-ground training with a mobile application and a data platform. So far, MAST has been piloted in parts of Burkina Faso, Zambia and Tanzania with the stated aims to (among others) prevent and mitigate conflicts over land and resources, create incentives to improve agricultural productivity, enable more responsible land-based investment, and to lay the ground for an efficient and sustainable natural resource management (Msigwa et al. 2018, USAID 2019), thus seemingly being a perfect tool to anticipate environmental futures in the Kilombero Valley.

3. MAST in Practice: Mapping Land and Shaping Hopes in Namwawala

The narratives accompanying the adoption of MAST in the Kilombero Valley clearly indicate how a long-term political challenge is being turned into a technological challenge (Weinberg 1993, see also Woods 2012 on "technological fixes" for rural futures). While, on the one hand, a new set of tools is supposed to reduce the costs and efforts of land formalization, on the other hand, the technology is regarded as a solution to land use conflicts by allowing all land users to make their claims, apparently independent of dominant power structures.

As Crampton and Krygier have highlighted, "cartography's latest 'technological transition' [...] is not so much a question of new mapping software but a mixture

of 'open source' collaborative tools, mobile mapping applications, and geotagging" (Crampton & Krygier 2006: 12, see also Monmonier 1985, Perkins 2003). The application of MAST is clearly situated in this "technological transition", aiming at empowering counter-mapping initiatives (see Hodgson & Schroeder 2002). Nevertheless, within the LTSP, the technology is entering rather top-down structures. First, the software specialist together with the programmer who initially designed and developed MAST for USAID had to adapt the application to the spatial context of the Kilombero Valley. On this basis, the mapping teams of the Land Tenure Support Program were then being trained how to use the registration, mapping, survey, and storage tools of the application.

Inside the Land Tenure Support Program

It was these technology experts who were our entry point to the ethnographic research that forms the basis of this article. While examining the role of digital technologies in informing human-nature relations in the Kilombero Valley, Astrid was able to visit all departments of the Land Tenure Support Program and regularly assisted the Geographical Information System (GIS) team (Fig. 2: The GIS department at the LTSP. Source: own photograph).

Fig. 2: The GIS department at the LTSP. Source: own photograph

One day, when the field workers came to the office of the LTSP in Ifakara to transfer the data from the tablets to the local server, she was invited to join the

field team on their new mapping project in Namwawala. During this process, she used the applications herself, got to know the different mapping and landscape elements and talked to both the field staff as well as the villagers about the difficulties and hopes of the program and its results. Over the course of six weeks, apart from numerous informal conversations, twenty interviews were conducted, eight of them with villagers, four with technology, software and GIS specialists, three with the project management and five with experts from associated areas of the project such as communication, social services, nature conservation, conflict consulting and the legal department. This way, this study resonates with newly emerging work in the field of non-, post-, or more-than-representational cartography, which is oriented towards processual, context-specific unfoldings of mapping as a narrative (Kitchin et al. 2013, Caquard & Cartwright 2014). Especially in the fields of the so-called spatial and digital humanities as well as in spatial anthropology, participant observation and observant participation in the creation and handling of maps have been advocated in order to bring social, cultural and political embeddedness into projects of "(digital) representation". Hence, "deep mappings" as a kind of equivalent to the "thick description" after Geertz, are on the rise (Roberts 2012, Roberts 2016) and have formed a major inspiration for this fieldwork.

Out in the Village

Namwawala is one of the villages in the Kilombero Valley situated directly along the railway line which leads from Dar es Salaam to Zambia. Here, before the mapping team arrived, the news about the project had already been spreading by word of mouth, radio and local drum-messengers. Namwawala is considered a state-approved village – implying an intact village government with democratically elected leaders – and officially, it is not affected by any conflicts. As such, it fulfils the two major prerequisites to participate in the program.

According to the formal structure of the LTSP, each village project starts with a couple of workshops to educate the villagers about the program and land rights. In addition, the planned restructuring of the legal apparatus in rural Tanzania, as well as infrastructure upgrades, are being discussed with the village government. After these trainings and discussions, the participation of the village in the project needs to be confirmed by both parties. If the village does not wish to pursue this extensive land formalization, it would however still have to cover the costs for the received trainings. Also, the program can withdraw its activities in case conflicts shine through in these training workshops. Thus, these are usually carefully hidden by the villagers at this stage, in order not to jeopardize their chances to acquire an official certificate for their land. After both parties have agreed to go on, the actual mapping process starts.

Only after the village government agreed upon the village boundaries as well as the new land use plan, focusing in particular on the separation of designated pastures from agricultural land, the final step of the LTSP's interventions can begin: the mapping and data collection of all the land holdings of each villager. This is meant to be done in a participatory process to increase the legitimacy of the data and related decision-making (see Gupta 2011). To ensure this, the mapping practice happens in a very specific constellation of people who accompany the tablet, the GPS and the App MAST through a village.

Fig. 3: A mapping team on its way through Namwawala, Source: own photograph

The field team of about 15 para-surveyors of the LTSP live in the village as long as they work there (usually a time period of four to eight weeks per village). While the para-surveyors watch over the tablets and GPS-devices, their mappings are supervised and corrected by a LTSP spatial planner and a number of selected villagers (Fig. 3: A mapping team on its way through Namwawala, Source: own photograph). Furthermore, each para-surveyor is assigned a secretary who creates the village household lists while s/he is doing the digital data recording. In addition, the owner of the property is present as well as his or her neighbors who are sought to control and verify the passages along the tangent borders. Finally, and arguably the most important person joining this process, is a representative of the Village Adjudication Committee (VAC) formed only for this purpose. Most of these representatives have been trained in land rights, community rights or conservation. Considered not only as knowledgeable and trustworthy but also as having a strong influence on the villagers, this person serves as a kind of organizer, leader, and impartial witness during the mapping process. After all, led by the

owner, followed by the para-surveyor and the tablet, watched by neighbors, the VAC and the secretary, the mapping teams make their way along the boundaries of land parcels in residential areas and farmland.

From Digital Information to Land Certificates

After a plot has been mapped, all the data of the owner and the neighbors are being recorded in detail in the tablet. This is at least how it should be done. In the residential area, 25 parcels as a minimun have to be mapped, described and corrected every day. This does not seem feasible to the team. The para-surveyors prefer to sit down in a shady hut and wait for all the people whose plots were mapped to come and report for data collection. The lengthy questionnaire contains census-like questions regarding the person, the household and its possessions. However, the people are willing to submissively give out their information and receive a small yellow note with some abbreviations, names and signatures in return. The fact that many wear their best clothes for this already indicates the meaning and hopes associated with this process.

When the office of the LTSP receives a finished dataset, corrections are made (if necessary) before the maps are being printed in Dar es Salaam. From there, they are sent back to the Kilombero Valley, where they are put up in the villages to allow for further comments and corrections. Finally, on that basis, the CCROs are printed, stamped, signed, laminated and handed over to the landowners. This way, more than 50,000 CCROs have already been distributed. These are seen to express the success of the project, which by mid-2019 had mapped 50 out of 81 villages in the Kilombero district.

This extensive granting of individual user rights generally reflects the long-standing assumption that an individual land title acts as a driver for agricultural intensification and sustainable resource use, even though this has hardly ever been proven in practice (Peters 2009). The CCROs are still promoted as a way to bring security, peace and development to the Kilombero Valley through clarified land conditions and the ultimate devolution of customary tenure systems through the penetration of statutory law into rural areas of Tanzania. However, a closer look at the mapping practices itself and its different im/material effects reveals that the process is not as straightforward as intended. In the following section, we will indicate some of the tensions and difficulties that emerged in this attempt to translate a dynamic and contested physical landscape into a digital map. This way, it will become clear how the measuring of plots through digital mapping hardly provides any "technological fix" but contributes in rather ambivalent ways to the production of future (in)securities.

4. The Production of (In)securities through Digital Measures

MAST as a collaborative mobile application fits the current cartographic trend to leave the terrain of academics and experts and form a more "undisciplined cartography" (Crampton & Krygier 2006: 12) instead. In the following, we will first focus on the different spatial knowledges and ways of measuring that come together during the process of translating physical elements of everyday life in Namwawala into a two-dimensional representation and digital database. Pointing to the new (in)securities that emerge as the one cannot correspond exactly to the other also reveals how mapping is always deeply intertwined with "the social, cultural and technical relations at particular times and places" (Kitchin & Dodge 2007: 333). With regard to the application of MAST in Namwawala, it becomes clear how customary and statutory laws, migration dynamics, relations to the government and external stakeholders, the project itself and its technical feasibility all contribute to the negotiation of spatial boundaries. In a second step, we will then illustrate the continuing tensions and new insecurities that emerge in the attempt to formalize land use. Driven by visions of change or deterred by fears of mediocrity and powerlessness, we show how anticipatory actions of cooperation and refusal are part and parcel of the process, which become inscribed in the emerging map. Finally, we take the first project results and its accompanying discourses as a starting point to critically reflect on the maps' ambivalent effects, paying particular attention to the (failed) hopes and promises associated with it in the first place.

4.1 The Translation of Physical Landscapes into Digital Space: (Re)shaping Plots

> "Then I was allowed to map a plot of land of an elder sitting in a corner eating dry cassava with a little salt and shouting across the street that he was clearly too old to walk around his plot. Soon, one of his sons appeared to lead me. Together, we walked along the locally identified features in the landscape. Trees served as cornerstones, wall projections as lines, changes of crops in front gardens or backyards as boundaries and trails as markers in the landscape. Sometimes things were planted or constructed exactly for this purpose, at other times ownership was highlighted through these features." (Research Diary, 28/03/2019)

For some time, we were walking through labyrinths of houses, huts, raw building

structures, fields, cowsheds, trees, bushes, and garbage dumps. Often, they seemed impenetrable and unmanageable. None of the paths were straight, nothing planned or clearly laid out. The landscape appeared dynamic and alive, meaningful and practical - not in the planning sense - but out of everyday life. However, through mapping, each parcel was put into a uniform shape and scale in the tablet.

As it is hardly visible to outsiders which of the trees actually represents a landmark of neighboring plots, the villagers need to point them out in this "cartographic encounter" (Lewis 1998, Short 2009). This way, on the one hand, the locally shared knowledge becomes transparent as a labeled GPS point in relation to three others. On the other hand, during this fixation or rather "geographic translation" (Belyea 1992) of the physical elements into a digital database, local ways of knowing are often challenged by different rules and ways of measuring that rather lead to abstraction and standardization.

When mapping the rice fields, for example, the mapping group suddenly came across a river and noticed that, by law, the border of the field should be 60 meters away from it. However, since the tablets were not able to connect to the internet in that place, it was impossible for the para-surveyor to load the satellite image and overlook the surrounding area. As it appeared to be too difficult to determine the legally correct boundary by foot - due to the size of the rice plants it was only possible to see the river when a foot already hit the water - this farmer was lucky, and his field was mapped as it appeared on the ground. But this was not always the case.

> "Between the mapping of the plots, we often had to discuss the roads. Those that already exist should have a width of five meters, but they hardly do. But instead of following their actual shape, they now have to be mapped as they should have been constructed and maintained. Other roads have to be newly constructed on the map, as there is a rule that every plot has to be accessible by road. So the roads are built, at least on the map." (Research Diary, 28/03/2019)

The roads are not the only elements that look different in the map than in the village. Apart from the given rules about shape, size and accessibility of a plot, the fixation of physical boundaries in the database is constantly informed by the base map depicting landscape features, but also former boundaries set by the government and the para-surveyors. These include the aforementioned village boundaries and the village land use plan, but they also show land possessions of companies or the church, protected areas and so-called reserved land, for example, the Tanzania-Zambia-Railway (TAZARA) and its buffer zone. Thus, when mapping the hamlet bordering the TAZARA buffer, the para-surveyors realized that quite a

number of houses reach into the railway buffer. After cross-checking again and again with both, the use of MAST as well as the commonly used footsteps, it was clear that these areas should not be mapped.

Fig. 4: Physical versus digital landscapes of Namwawala, Source: own photograph

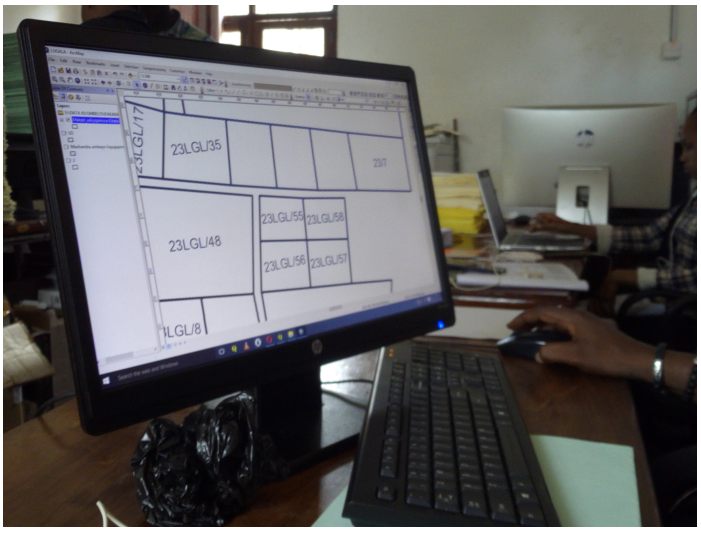


Fig. 5: Physical versus digital landscapes of Namwawala, Source: own photograph

This shows how the rules and guidelines accompanying the application may lead to a considerable reduction of the land of the farmers on the map, and it also severely alters its shape (Fig. 4 & 5: Physical versus digital landscapes of Namwawala, Source: own photograph).

The shape is usually derived from four corner points. Moreover, the maximum size of each parcel is given, so that larger parcels have to be divided. As a result, clear, straight parcels of similar size emerge digitally, which are hardly recognizable when walking through the village. They certainly look very different to the plots that were commonly measured when being allocated, sold or leased among the villagers. Usually, this is done with a measuring rope with a scale of ten knots composing the length of one acre. For uneven or smaller areas of land, footsteps are taken. But even though these conventional methods are also based on the metric standard system and stick far more closely to the actual shape, the new, digital way of mapping is still perceived as more accurate by the villagers. As one farmer states:

> "It does not change my life but it helps me to know my plot. You can measure by using a rope and you believe that you have five acres while they are less than that. If you use this technology, you are sure of the area you own and it helps you to determine the capital you can produce. It is a clear projection I can make now." (Interview with farmer, 19/04/2019)

This statement also reveals how this supposedly new and more exact way of knowing one's land is closely related to new methods of working one's land as they have been promoted recently, such as projections for seeds, inputs and yields that are tuned to exact spatial measures. Thus, even if the digital mapping might mean that parts of one's plot need to be deduced because of a planned road or to allow the old road to appear as wide as it should be, the accuracy of the new measurement and its clear shape is still seen as an asset by many, as they hope to be able to link the formalization of land to increased productivity, as SAGCOT has promised - even if mainly with regard to large-scale investors.

Overall, the ethnographic insights show how the translation of physical landscapes into the digital database is far from straightforward with diverse effects. For those plots successfully mapped, the owner will be informed of his or her field size as digitally measured by MAST. The size will be noted on the CCRO, as well as the shape of the plot. Other parts, however, will be excluded and other land uses are assigned to it through the base map, which is constantly referred to and thus looms like a shadow over the negotiations on the ground. This means that this process of mapping and "unmapping" of the village, as Roy (2003) puts it, is conducted under tension as it is decided upon residents, if they will own the land they currently use forever or never. In this sense, as the following will illustrate, mapping and unmapping becomes a constant process of anticipatory negotiation between the diverse actors involved.

4.2 The (In)formalization of Present Land Use: (Re)assigning Ownership

Tensions among Namwawala residents have been there for a long time, with a major line of conflict between the "locals/natives" (in Kiswahili "wenyeji" and thus not necessarily dependent on birth), which are comprised of people from different tribal backgrounds having arrived in the Kilombero Valley from pre-colonial times until the mid-twentieth century, and the "newcomers", Tanzanian migrants who have arrived since the Sixties, however mainly used to refer to (agro-) pastoralists from further north (e.g. Wasukuma). The "newcomers" are seen, not without jealousy, as the driving forces behind novel farming methods and modern house constructions. In general, they are considered to be "more economic". As (agro-)pastoralists they are responsible for the spread of the highly disputed livestock farming in the valley, with some occupying large pieces of land which they are thought to have acquired through bribes to the village leaders, so at least the local elders say. What is causing particular tensions is the observations that "newcomers" often do not know about or respect the land demarcations made by former customary land users. As this elder complains:

> "If they would only invade the land that is still unattended or just bush… but when I was transferred first to Zambia and then to Mngeta [to work for the railway], someone invaded my land. After my return in 2012, I was shocked that a large part of my land was gone. This happened with disregard to the demarcations I had done with sugarcane." (Interview with elder, 18/04/2019)

However, legal standards and local customs may not only be unfamiliar to "newcomers". On the one hand, the Tanzanian legal framework has hardly penetrated to rural areas, so that only few people in the villages know about their rights, and local jurisdiction is hardly based on it. On the other hand, it is also difficult to decide what can be considered as local customary law, especially in a fertile area such as the Kilombero Valley with a highly dynamic population. Moreover, even laws commonly accepted may not always be enforced. In effect, it is difficult to say who is legally or illegally using land.

In this complex and rather unclear legal setting, MAST is used in anticipation of a further proliferation of conflict outbreaks. Fixing borders and making them transparent, it should serve as a clear legal basis for the application of state laws and therefore forms a central component in the transition from customary tenure to statutory law. Apart from providing some rules and guidelines, such as those concerning maximum plot size and shape, the decisions regarding concrete boundaries and ownership, however, have to be made by the team accompanying

the mobile application on the tablet. As presented before, apart from the para-surveyor this includes the landowner – or at least present land user –, his or her neighbors, and the representative of the Village Adjudication Committee (VAC), whose general role it is to solve land conflicts according to local customs, modelled on the role of the elderly. Thus, the decision-making authority is seemingly shifted to the villagers themselves with the aim to create an atmosphere of trust which is not always given in relation to the village government, half of which consists of appointed external representatives of the state. Due to the heterogeneity of actors and unknown or contested local customs, these teams, however, often still have to deal with doubts and suspicion, and were sometimes even met with complete refusal when arriving on farms.

> "When it stopped raining, we took two motorcycles in the direction to the fields. Mainly rice is cultivated here, as well as maize, and I also see some cattle. The farm-roads are narrow, washed up and muddy, some even completely flooded. Half an hour later, and after having had to lift the motorcycles over a bridge, which only consisted of a log, a man is waiting for us at a shady glade. We stop and everyone begins to whisper. After a while, I get nervous. Is the path not passable, or were the para-surveyors not found? After a long discussion, the spatial planner comes to me to explain that we are about to enter the farm of a Msukuma who is still hesitant towards the mapping as he fears to lose this land to investors. Luckily, the VAC accompanying the group is also a Msukuma. He steps out to explain the whole process to the farmer. Finally, we are allowed to enter the farm." (Research Diary, 01/04/2019)

The LTSP team often had to do a lot of convincing because the farmers were afraid of investors. In this area, in particular, they feared that the Kilombero Sugar Company (KSC), partly owned by the state, would expel them from their land. After the company was originally given land in a protected area which it had to return in response to the complaints of environmental organizations, they were first compensated with land belonging to the rice fields of Namwawala. After protests broke out in the area, it was established that the land should remain in use by the villagers and the company received a monetary compensation instead. Nevertheless, rumors and fears regarding the KSC appearing to take this land remain, especially as the company only recently tried to expand its activities by reclaiming land in other parts of the valley.

> "The farms of Wasukuma that we visit are large and located far outside the village, yet close to a protected area. Unlike other villagers who usually have their houses in the residential area, these farmers live on their farms. For the para-surveyors, mapping these farms is particularly difficult. As he tells me, many Wasukuma were hiding from the team and did not want to be mapped. They are afraid that it might turn out that they had expanded their fields at the expense of the protected area." (Research Diary, 01/04/2019)

As outsiders, such as state officials or NGO workers, who previously arrived in this area were often associated with either external investments or conservation, both at the expense of local farmland, MAST, as well, is seen to bring uncertainty. Before the mapping is completed, it is hard to tell what it will bring.

Instead of simply confirming land use as well as demarcating available land, it rather points to overlapping land (mis)uses when looking through official maps and legal frameworks. Farmland that extends into other areas is not mapped; buildings in buffer zones, for example, are marked with the letter X, meaning that they shall be torn down in the future. In the case of the TAZARA railway line, so far, it is unclear if and when this will happen, as it depends on a possible upgrading and extension of the railway. However, the residents inside the TAZARA railway buffer zone will not receive a certificate.

In effect, through MAST, some villagers who have long used their land according to previous customs and rules, now become officially landless as their land extends into a protected area or a buffer zone, or simply sits in conflict with other, previously invisible land uses, owners or investors as depicted in the base map. By the residents in Namwawala, these new landless are generally considered to be the greatest risk in terms of future conflicts and crime and stand in stark contrast to the original hopes associated with secure tenure. Furthermore, there is a lot of resentment in the village, because, some residents who have only informally acquired their land, did not follow local customs or were still in conflict as their land ownership was contested by neighbors, are now suddenly assigned the official landowners, and can secure their current possessions in the long term through newly set inheritance regulations. Overall, this clearly shows how MAST redefines formal and informal land-use for the inhabitants of Namwawala by (re) assigning and withdrawing land ownership.

4.3 Repercussions from the Database: (Re)setting the Future

The translation process of different forms of spatial knowledge into a digital

dataset and the new definitions of formal and informal which come along with this determines if someone becomes a proper landowner or an official landless, thus epitomizing the complex interplay of the digital and the physical. As indicated above, the digital base map always serves as reference and orientation during the fixation of locally defined and negotiated borders. Besides, it informs the mapping of those boundaries which are not known or ignored by customary use. Thus, while a major effort is put into digitizing the physical landscape, the digital map already exerts its influence on the ground during the mapping process. Moreover, it is the expected result that triggers further expectations and material repercussions.

> "I can refer to one example, if I have five people in my family, I know that I have to cook a certain amount of food. Through the project, I believe, if the government knows that people of a certain area own a certain area of land, it is easier for the government to provide help. They will know the largeness of the area and the inputs required in agriculture. Previously, the area was not exactly known, the total number of farmers neither." (Interview with VAC, 19/04/2019)

Even though the Kilombero Valley, traditionally associated with the opposition party, has often felt neglected by government efforts to strengthen rural areas, some villagers clearly hope that MAST will put their village on the map when it comes to agricultural policies and other rural development initiatives. Here, the mapping is seen to provide the government with the necessary knowledge to design more appropriate measures for their support. Hence, participating in the program is closely associated with the hope to participate in and benefit from development projects. In a way, this shows how the program's guiding idea of idle land as an untapped resource that needs to be made investable is transformed into a notion of long-awaited care by the state for the inhabitants by knowing about their properties.

However, some fear that this knowledge about ownership and the size of properties might lead to tax collection and tax increase. As one farmer emphasizes:

> "At first, people couldn't imagine what will happen or change through and after the project. Many people rejected the program after hearing that after registering they would have to pay tax for their lands. But later, when they were informed through seminars from the government, they accepted. […] Now, they expect things such as getting loans to become much easier if your land is legalized. The truth is, as they were trained and educated, they realized that there is success ahead of them." (Interview with farmer, 19/04/2019)

For many farmers, the hope for loans dispels fears of tax payments, as they expect that trusting in MAST will be rewarded with being trusted by banks. This is certainly considered to be one big advantage of a transparent digital database, which can supposedly be accessed easily by financial institutions and illustrates again how the aims and activities of the LTSP are appropriated in the process by the villagers. Finally, the digital map itself seems to incorporate a particular vision of the village.

> "A thing that inspired me when we were in this mapping process was to see in the tablet how the village will look like. It was inspiring me so much. It is like visualizing the future of this village." (Interview with VAC, 19/04/2019)

According to the map, the village has clearly arranged blocks of parcels which are accessible via wide roads. On the tablet, Namwawala also has an area for social and health services as well as an industrial zone. In particular, the straight, rectangular and arranged polygons on the map suggest uncontested and clear borders in the residential area, in between fields, between farmland and protected or reserved areas and, most importantly, between agricultural land and village pastures. This representation nourishes the vision of a "more developed" and conflict-free village. In light of its emergence and the many contestations and disappointments it triggered during its production, it is clear that this map only shows one of many alternative futures, probably a rather unlikely one. Yet, it portrays an "indeterminate potentiality" (Massumi 2007) by performatively establishing the presence of what has not happened and may, in fact, never happen (Kinsley 2010).

And, indeed, there are already some strong indications that the digital map as an anticipatory device will not serve as a dynamic basis for further development visions and conflict prevention in the village. Despite the participatory approach advocated by the LTSP, the para-surveyors were strictly prohibited to give the tablets to the villagers. In consequence, the residents of Namwawala were not able to learn how to use the mobile application.

> "We shall not measure or register again because we do not have this machine which is used to measure. It is not really sustainable. We cannot divide the land into pieces for our children. Only them, they are measuring our lands by using these machines. Will these machines remain here, if I get into conflict with my neighbor concerning boundaries? Maybe we need to check again where the boundaries were in the machine. But people lied to us that maybe the machines stay here, maybe not." (Interview with VAC, 19/04/2019)

As this VAC infers with disappointment, the tablets, the data base and, with it, the digital map leave Namwawala with the LTSP after the mapping is finished. This way the villagers are prevented from formally trading land, dividing and merging parcels, changing the names of inheritors and, most importantly, they cannot clarify conflicts on the basis of the new data base. In this regard, the presumed effects of the project seem rather questionable. In contrast to the production of a dynamic digital map which accounts for actual processes in a timely manner, it appears simply as a new version of a classic land use map. Though in digital format it rests far away, out of sight and therefore also out of use for some of the most crucial local demands, leading to new uncertainties as the actual use of the map and any digital editions remain invisible for the residents in Namwawala.

5. Conclusion

African rural landscapes have received increasing attention in the wake of climate change, projected population growth, increasing conflicts over land and questions of food security. While some see huge potential in "awakening a sleeping giant" through agricultural intensification, others rather fear a rise of conflicts and resource degradation. Both of these contrasting visions, however, contribute in particular ways to what has been called a "regime of anticipation" (Mackenzie 2013: 391), a state characterized by a thinking and living toward the future (Adams et al. 2009: 246). In this regard, the Land Tenure Support Program and the use of MAST in the Kilombero Valley can be read as one way in which the present is transformed, intervened in and ultimately governed in the name of the future (Granjou et al. 2017).

In this case, the reliance on a mobile application shows how an uncertain future is, first of all, rendered a technical issue. Using a participatory approach and new digital technologies, MAST is regarded as a straightforward tool to bring clarity into current land issues. Being able to issue CCROs for each and every villager is expected to not only prevent increasingly violent conflicts over land, but also to be able to identify investible land to boost agricultural production. A closer look at this digital technology and the ways in which it becomes entangled into the local context on its way through the village, however, shows how the diverse (material) affordances that come along with it not only create new securities but rather contribute to new insecurities and conflicts.

First, the mapping narratives from Namwawala, one village in the Kilombero Valley, shed light on the complex process and effects of institutionalized land demarcation in an area of multiple interests and uses. As Li (2014) has pointed out, land, indeed, seems to be a recalcitrant element in the calculation of a state that is keen to attract foreign investment. While the Tanzanian state openly announces

that there is investible land to be consolidated in a Land Bank, ready for fast-track investments in the SAGCOT clusters, the situation in Namwawala indicates that this land is hardly unused but forms a central part of often overlapping, multiple interests and practices. These are highlighted in the digital map, as it allows to include multiple layers which bring together government perspectives, abstract rules and guidelines, and the concrete practices on the ground. Nevertheless, even if the digital mapping device may visualize multiple uses, CCROs will only be issued when land use is clear and does not overlap with any other function of the land as determined in general land use and development plans. Therefore, instead of securing tenure and highlighting idle land, some actors are rendered officially landless, and plots need to "be emptied", not to be made ready for investment, but to fulfil the demands of buffer zones or protected areas. Those who will finally receive a CCRO might not recognize their land on it, as it may have been reduced in size and adapted in shape to fulfil the requirements of road access and other infra-structural demands. Overall, regulations and guidelines as well as diverse technical affordances make it impossible for the virtual map to match the actual situation.

Nevertheless, the digital technology bears hope for more accuracy and accountability, and appropriate provisions by the state for this remote area. During the mapping process this becomes apparent in unquestioned and voluntary sacrifices of private land for public interests. Often, this is closely related to hopes concerning loans as well as an increasing credibility more generally as soon as one holds a CCRO. However, the digitization as well as the formalization, through their need to either map or unmap, formalize or informalize, create new insecurities. In this regard, fears of losing land lead to diverse anticipatory actions on the side of the farmers, as, for example, hiding from the mapping team or openly rejecting to participate in the process of land (in)formalization. Therefore, the resulting digital map itself, though seemingly offering transparency, only offers a limited view of the village. Due to the fact that the map stays out-of-reach for the farmers, doubts about enhanced development through this technological fix increase even further. Instead of being a tool which is able to more accurately record the dynamics on the ground, it becomes a fixation, a snapshot, unavailable for further changes and adaptations.

Yet, the creation of this kind of representation by means of digital technologies and tools of visibility (Roy 2009) can hardly work as securing and stabilizing. Not only the maps themselves are meanwhile regarded as processual and never complete. As Kitchin and Dodge have emphasized, "it is productive to rethink cartography as ontogenetic in nature; that is maps 'emerge' through practices and have no secure ontological status" (Kitchin & Dodge 2007: 331). In this vein, this contribution shows that, instead of foregrounding the resulting map as an at least momentarily stabilized entity, only a closer investigation of the digital mapping itself is able to reveal its complexity and contingency as a form of anticipatory governance in

which the future is not shaped by humans alone (Granjou et al. 2017). While paying particular attention to the (im)possibilities of translating a physical landscape into a digital database, it also highlights critical issues in the opposite translation process, as the digital representation challenges actual practices and their material manifestations. So far, the anticipated effects of MAST remain limited. However, a number of (unintended) side effects and diverse (in)securities have taken shape. The future will tell, in how far the digital will be performative to actually change the physical world in the Kilombero Valley and what kind of anticipatory actions will be taken by the different actors to counter them.

Authors

Astrid Matejcek is PhD candidate in Geography at the University of Mainz, Germany, and Junior Researcher in the Collaborative Research Centre "Future Rural Africa" funded by the German Research Council. Her interest is in human-technology-environment relations, with an empirical focus on agricultural transformation in East Africa.

Julia Verne is Professor of Cultural Geography at the University of Mainz, Germany. She has done long-term ethnographic research in Eastern Africa and the Indian Ocean World with a specific interest in mobilities and human-technology-nature relations.

References

Adams, Vincanne & Murphy, Michelle & Clarke, Adele E. (2009): "Anticipation: Technoscience, life, affect, temporality," *Subjectivity*, 28:1, 246-265.

Anderson, Ben (2007): "Hope for nanotechnology: anticipatory knowledge and the governance of affect," *Area*, 19, 156-165.

Beck, A.D. (1964): "The Kilombero Valley of South-Central Tanganyika," *The East African Geographical Review*, 2, 37-43.

Belyea, Barbara (1992): "Amerindian maps: the explorer as translator," *Journal of Historical Geography*, 18:3, 267-277.

Caquard, Sebastien & Cartwright, William (2014): "Narrative Cartography: From Mapping Stories to the Narrative of Maps and Mapping," *The Cartographic Journal*, 51:2, 101-106.

Collier, Paul & Dercon, Stefan (2014) "African Agriculture in 50Years: Smallholders in a Rapidly Changing World?," *World Development*, 63, 92-101.

Cotula, Lorenzo (2013): *The great African land grab?: Agricultural investments and the global food system*, London: Zed Books.

Crampton, Jeremy W. & Krygier, John (2006): "An Introduction to Critical Cartography," *ACME: An International E Journal for Critical Geographies*, 4:1, 11-33.

Dinesen, Lars (2016): "Kilombero Valley Floodplain (Tanzania)," Max Finlayson & Mark Everard & Kenneth Irvine & Robert McInnes & Beth A. Middleton & Anne van Dam & Nick Davidson (eds): *The Wetland Book*, Dordrecht: Springer, 1-8.

Granjou, Celine & Walker, Jeremy & Salazar, Juan F. (2017): "The politics of anticipation: On knowing and governing environmental futures," *Futures*, 92, 5-11.

Groves, Christopher (2017): "Emptying the future: On the environmental politics of anticipation," *Futures*, 92, 29-38.

Gupta, Aarti (2011): "An evolving science-society contract in India: The search for legitimacy in anticipatory risk governance", *Food Policy*, 36, 736-741.

Hodgson, Dorothy L. & Schroeder, Richard A. (2002): "Dilemmas of Counter Mapping community resources in Tanzania," *Development and Change*, 33, 79-100.

Jarvis, Andy & Reuter, Hannes Isaak & Nelson, Andy & Guevara, Edward (2008): "Hole-filled seamless SRTM data V4", International Centre for Tropical Agriculture (CIAT): http://srtm.csi.cgiar.org, (accessed 01/04/20).

Jasanoff, Sheila (2003a): "Technologies of humility: citizen participation in governing science," *Minerva*, 41, 223-244.

Jasanoff, Sheila (2003b): "(No?) accounting for expertise," *Science and Public Policy*, 30:3, 157-162.

Kangalawe, Richard & Liwenga, Emma (2005): "Livelihoods in the wetlands of Kilombero Valley in Tanzania: Opportunities and challenges to integrated water resource management," *Physics and Chemistry of the Earth*, 30, 968-975.

Kimaro, Didas (2014): "Potential land for agricultural use in Tanzania: the case of Kilosa District," *Journal of Land and Society*, 1:1, 14-24.

Kinsley, Samuel (2010): "Representing 'things to come': feeling the visions of future technologies, "*Environment and Planning A*, 42, 2771-2790.

Kitchin, Rob & Dodge, Martin (2007): "Rethinking Maps," *Progress in Human Geography*, 31:3, 331-344.

Kitchin, Rob & Gleeson, Justin & Dodge, Martin (2013): "Unfolding mapping practices: A New epistemology for cartography," *Transactions of the Institute of British Geographers*, 38, 480-496.

Lewis, G. Malcolm (ed.) (1998): Cartographic Encounters: Perspectives on Native American Mapmaking and Map Use. University of Chicago Press. Chicago.

Li, Tania M. (2014): "What is land? Assembling a resource for global investment," *Transaction of the Institute of British Geographers*, 39, 589-602.

Mackenzie, Adrian (2013): "Programming subjects in the regime of anticipation: Software studies and subjectivity," *Subjectivity*, 6:4, 391-405.

Massumi, Brian (2007): "Potential Politics and the Primacy of Preemption," *Theory & Event*, 10: 2, 2007. *Project MUSE*, 2007: https://muse.jhu.edu/article/218091, (accessed 07/09/21).

Milder, Jeffrey & Buck, Louise & Hart, Abigail & Scherr, Sara (2012): *The SAGCOT Greenprint. A Green Growth Investment Framework for the Southern Agricultural Growth Corridor of Tanzania*, Dar es Salaam: SAGCOT Tanzania.

Monmonier, Mark S. (1985): *Technological Transition in Cartography*, Madison: University of Wisconsin Press.

Monson, Jamie (1993): "From Commerce to Colonization: A History of the Rubber Trade in the Kilombero Valley of Tanzania, 1890-1914," *African Economic History*, 21, 113-130.

Msigwa, Malaki & Issa, Mustapha & Sullivan, Tressan & Solovov, Alexander & English, Clive (2018): *Mobile Applications for Secure Tenure (MAST) and the Technical Register for Social Tenure (TRUST): development and applications in Iringa and Mbeya Districts in Tanzania*, Feed the Future, Tanzania Land Tenure Assistance, DAI Global: World Bank Conference on Land and Poverty: Land Governance in an interconnected World, Washington DC: The World Bank.

Nindi, Stephen J. & Maliti, Hanori & Bakari, Samwel & Kija, Hamza & Machoke, Mwita (2014): "Conflicts over land and water resources in the Kilombero Valley Floodplain, Tanzania," *African Study Monographs*, 50, 173-190.

Odgaard, Rie (2002): "Scrambling for Land in Tanzania: Processes of Formalisation and Legitimisation of Land Rights," *The European Journal of Development Research*, 14:2, 71-88.

Perkins, Chris (2003): "Cartography: mapping theory", *Progress in Human Geography*, 27, 325-35.

Peters, Pauline E. (2009): "Challenges in Land Tenure and Land Reform in Africa: Anthropological Contributions," *World Development*, 37: 8, 1317-1325.

Roberts, Les (2012): "Mapping Cultures: A Spatial Anthropology," Les Roberts (eds): Mapping Cultures, London: Palgrave Macmillan.

Roberts, Les (2016): "Deep Mapping and Spatial Anthropology," *Humanities*, 5:5, 1-7.

Rose, Nikolas (1991): "Governing by Numbers: Figuring out Democracy," *Accounting, Organizations and Society*, 16:7, 673-692.

Roy, Ananya (2003): *City requiem, Calcutta: gender and the politics of poverty*, Globalization and community 10, Minneapolis: University of Minnesota Press.

Roy, Ananya (2009): "Why India cannot plan its cities: Informality, Insurgence and the idiom of urbanization," *Planning Theory*, 8: 1, 76-87.

SAGCOT Center Ltd (2017): "Southern Agricultural Growth Corridor of Tanzanian", SAGCOT.co: https://sagcot.co.tz, (accessed 01/04/20).

Schneider, Leander (2014): *Government of Development: Peasants and Politicians in Postcolonial Tanzania*, Bloomington: Indiana University Press.

Shauri, Vincent (1999): "The New Wildlife Policy in Tanzania. Old Wine in a New Bottle? Economic and Social Research Foundation", Tanzaniagateway.org, April 1999: http://www.tanzaniagateway.org/docs/The%20new_wildlife_policy_in_Tanzania.pdf, (accessed 01/04/20).

Starr, Chauncey (1969): "Social benefits versus technological risk: what is our society willing to pay for safety?," *Science*, 165, 1232-1238.

Sulle, Emmanuel (2016): "Social Differentiation and the Politics of Land: Sugar Cane Outgrowing in Kilombero, Tanzania", *Journal of Southern African Studies*, 43:3, 517-533.

United Nations Environment Programme - World Conservation Monitoring Centre & International Union for Conservation of Nature (2021): "Protected Planet: The World Database on Protected Areas (WDPA) and World Database on Other Effective Area-based Conservation Measures (WD-OECM)", February 2021, Cambridge, UK: UNEP-WCMC and IUCN: www.protectedplanet.net, (accessed 01/04/20).

United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2018): "Selous Game Reserve: World Heritage Convention", Unesco.org: https://whc.unesco.org/en/list/199, (accessed 01/04/20).

United States Agency for International Development (USAID) (2019): "MAST in the Field: Tools and Mission Resources", Land-Links.org, https://www.land-links.org/tool-resource/mast-in-the-field/, (accessed 01/04/20).

Weinberg, A. (1993). "Chapters from the life of a technological fixer", *Minerva*, 31, 379-454.

Wildlife Division Tanzania (2002): "Ramsar Information Sheet for Kilombero Valley Floodplain", Rsis.ramsar.org, 25 April 2002: https://rsis.ramsar.org/RISapp/files/RISrep/TZ1173RIS.pdf, (accessed 01/04/20).

World Bank (2009): "Awakening Africa's Sleeping Giant: Prospects for Commercial Agriculture in the Guinea Savannah Zone and Beyond", Worldbank.org, 01 January 2009: http://www.documents.worldbank.org/curated/en/312591468004457911/Awakening-Africas-sleeping-giant-prospects-for-commercial-agriculture-in-the-Guinea-Savannah-zone-and-beyond, (accessed 01/04/20).

World Bank (2009): "Awakening Africa's Sleeping Giant: Prospects for Commercial Agriculture in the Guinea Savannah Zone and Beyond", Worldbank.org, 01 January 2009: http://documents.worldbank.org/curated/en/312591468004457911/Awakening-Africas-sleeping-giant-prospects-for-commercial-agriculture-in-the-Guinea-Savannah-zone-and-beyond, (accessed 01/04/20).

World Bank (2013): "Growing Africa. Unlocking the Potential of Agribusiness. Financial and Private Sector Development Department Agriculture",

Worldbank.org, 11 March 2013: http://documents.worldbank.org/curated/en/327811467990084951/Main-report, (accessed 01/04/20).