Land Use Policy 42 (2015) 652–663

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Constructing landscapes of value: Capitalist investment for the acquisition of marginal or unused land—The case of Tanzania

Andreas Exner[a,*], Lara E. Bartels[b], Markus Windhaber[c], Steffen Fritz[d], Linda See[d], Emilio Politti[a], Stephan Hochleithner[e]

[a] Environmental Consulting Ltd., Bahnhofstraße 39/2, 9020 Klagenfurt, Austria
[b] Institute of Social Ecology Vienna, Alpen-Adria University (Klagenfurt-Vienna-Graz), Schottenfeldgasse 29, 1070 Vienna, Austria
[c] Donaustraße 3, 3422 Greifenstein/Altenberg, Austria
[d] Ecosystems Services & Management Program, International Institute for Applied Systems Analysis, Schlossplatz 1, 2361 Laxenburg, Austria
[e] Department of Geography, University of Zürich, Winterthurerstrasse 190, 8057 Zürich, Switzerland

ARTICLE INFO

Article history:
Received 6 December 2013
Received in revised form
26 September 2014
Accepted 7 October 2014

Keywords:
Biofuels
Marginal land
Unused land
Land grab
Nature conservation
Tanzania

ABSTRACT

The current global wave of land acquisition – variously debated as land grabbing or investment in land – is promoted by the World Bank and the FAO as creating win–win-situations for local populations and investors alike. Common policy recommendations suggest expanding the production of export crops, by making use of marginal or unused land. Considerable potentials for such an expansion are assumed. Taking Tanzania as a case study, the evidence for such types of land is assessed by using a broad range of statistics. We will argue firstly, that the terms marginal and unused land serve as a manipulative terminology for the benefit of attempts to commercially valorize and commodify African landscapes, from biofuel to large-scale food production and tourism. However, they relate to different rationalities of domination. Unused land refers to a state-bureaucratic narrative, which excludes user groups deemed irrelevant for national development, while marginal land refers to a capitalist-economic narrative that excludes what is not profitable. Secondly, the terms are analyzed as categories central for state simplification of social relations attached to land. Modelling of these land use categories based on remote sensing is an attempt to compensate weak state capacities to enhance the legibility of the landscape by constructing it as a landscape of commercial value.

Introduction

The assumption that areas not cultivated, but suitable for commercial agriculture exist has become one of the major arguments pro large scale agricultural investments in the discourse on land acquisition (Deininger, 2011). Yet, two problems concerning this argument have been indicated. Firstly, taking a closer look, one can differentiate two terms referring to land suitable for investments: "unused land" and "marginal land" (Nalepa and Bauer, 2012; Altvater and Geiger, 2010; Exner, 2011), whereby the notion of marginal land emerged mainly in the context of the biofuel discourse (Widengård, 2011). While these two terms obviously refer to different types of land, they very often lack a clear definition. Even the very accurate study of Nalepa and Bauer (2012) (see e.g. p. 404) fails to clearly differentiate them.

Secondly, leaving the problem of finding an unambiguous definition of the terms aside, global assessments have not been able to provide conclusive evidence that land, which is effectively unused or marginal, exists to a significant amount (Nalepa and Bauer, 2012) or to the amount necessary to meet biofuel requirements set by current policy targets (Fritz et al., 2013).

Furthermore, in many African countries, nature conservation claims considerable swaths of land. Conflicts with local populations persist or arise in new projects to increase foreign exchange income, since nature conservation there often relies on the idea that land is not or hardly used or that it should in any case not be used for sustaining local livelihoods.

Two questions arise from this context: (1) which are the concepts and mechanisms embedded in the narratives of unused and marginal land, and (2) what are the sources and the quality of data, which serve to underpin these narratives?

To answer these questions, we will investigate the concepts of unused and marginal land in a specific geographical and

* Corresponding author. Tel.: +43 0 69912723887.
E-mail addresses: andreas.exner@aon.at (A. Exner), lara@web-bartels.de (L.E. Bartels), markus.windhaber@ecopolicy-lab.org (M. Windhaber), fritz@iiasa.ac.at (S. Fritz), see@iiasa.ac.at (L. See), emiliopolitti@gmail.com (E. Politti), Stephan.Hochleithner@geo.uzh.ch (S. Hochleithner).

http://dx.doi.org/10.1016/j.landusepol.2014.10.002
0264-8377/

socio-economical context, drawing on cases from Tanzania. This country has been studied extensively regarding land use in general and specifically in regard to large scale agricultural investments and nature conservation (Ngoitiko et al., 2010; Matondi et al., 2011; Bartels, 2013; Exner, 2013).

The construction of marginal and unused land as narratives

Before discussing the possible extent of marginal and unused land, a distinction has to be made between the two terms, since they refer to different theoretical concepts and to different types of land. A circumstance ignored by some studies, which use the terms inaccurately or even synonymously (see Kachika, 2010; Cotula et al., 2008). The use of substitutes, like "idle land, degraded land, unproductive land, underutilized land, wasteland, reserve land" (Kachika, 2010: 22), "abandoned land", "barren land" (Cotula et al., 2008: 21f), "sleeping land", "set aside land" (The Gaya Foundation et al., 2008: 1, 5), contribute to a confusing inaccuracy. So far, there is no consensus on an unambiguous definition of marginal land or unused land. The complete lack of a definition in many approaches renders the application of these terms even more problematic, leaving the interpretation of the terms' meaning more or less to the recipient. Although these circumstances create an interpretative uncertainty, it can be argued that the terms marginal and unused land evoke historically quite different patterns of meaning, which express different rationalities.

Drawing on existing definitions, two ascribed characteristics can be identified for marginal land: (1) marginal productivity (and therefore marginal economic return) due to biophysical constraints and, in some cases, (2) marginal use of the land, due to constraints, for instance, in access (also implying marginal returns).

The so called Gallagher Review, which focuses on indirect effects of biofuel production, gives an example for a definition of marginal land based on biophysical constraints: "Land unsuited for food production, e.g. with poor soils or harsh weather environments; and areas that have been degraded, e.g. through deforestation" (Renewable Fuels Agency, 2008: 33).

Interpreted under the perspective of early 20th century economic theory, as for example by Peterson and Galbraith (1932), the focus is being set on the notion of intensive and extensive margins:

> "Assuming price response, these margins are extended with price increments roughly to the point where the extra production is barely remunerated and are similarly contracted with price diminution [clarifying that in] terms of physical grade of land the economic margin is at the 'poorest' land which can be 'remuneratively' operated 'under given price, cost, and other conditions"' (1932: 296, emphasis in the original; see also Ellison, 1953).

Marginal land does not preclude agricultural uses and includes land that can be tilled economically to a certain degree if access is well developed via roads. Marginal land will indeed often be found as used at any given time. However, in the current discourse on marginal land, it is being assumed that the outer frontier of marginal land has expanded because of (1) increased demand for biofuels, which can (2) allegedly be produced with crops, which are, it is being suggested, more tolerant of unfavourable environmental conditions such as drought or poor soils than crops used for conventional purposes.[1] Because of these assumptions, land which was not marginal before, is often regarded as marginal land – thus this "new" marginal land is the focus within the biofuel discourse. The current debate on marginal land is the reflection of changing economic incentives, where marginal land is a dynamic category, not a static classification of land. As a result of putting "new" marginal land into use, a net expansion of land used for crop production is assumed. Unused land, on the contrary, seems to be only characterized by purported "under-utilization", while being arable under any circumstances (see more below).

Thus, the notion of marginality actually evokes two types of interpretation: the first one is closer to the economic principle of marginality, where marginal land is a shifting category depending on current technology, profit rates in capitalist agriculture and so on (Nalepa and Bauer, 2012); the second one alludes more to everyday language, in which marginal means peripheral. However, the notion of periphery is in itself ill-defined unless the benchmark of marginality (smallholder production, subsistence or industrial agriculture for national or world markets) or the centre to which periphery refers (the global North, the nearest city, the capital of a nation, an individual smallholder etc.) are given. Both aspects are interrelated, because peripheral regions are usually also regions with low profit rates or few opportunities for capitalist (i.e. profitable) investment.

As already mentioned, the notions of unused and marginal land differ largely, if the whole range of meanings is taken into account. The principle of marginality in a capitalist sense introduces a specific economic rationality for assessing land, ignoring actual forms of use. The term unused land, on the contrary, implies the physical absence of use or the absence of significant use and, thus, users, where the land is regarded as being definitively arable.

In an African context, the notion of unused land is tightly connected to colonial visions of "landscapes" embodying "wilderness" (Neumann, 1998). What was interpreted as "wilderness" by colonial officers and conservationists, i.e. as land not used by humans, very often actually was a cultural landscape, crucially important for local livelihoods (Neumann, 1998; Kjekshus, 1977; see contributions in Maddox et al., 1996).

The notion of unused land thus has a strong relationship to discourses and practices of nature conservation, which are an important form of land grabbing in Tanzania, mainly affecting pastoralists (Bartels, 2013). Also, the category of unused land is prominently featured in Tanzanian land use regulation, as – according to the Land Act (URT, 1999b) – unused land automatically becomes state land, i.e. does not fall into the administration of the villages. On the other hand, the practice of using of land – in a quite broadly conceived manner – defines it as village land according to the Village Land Act (URT, 1999a). This contradiction between Tanzania's two main land regulations has been pointed out by several authors (e.g. Olenasha s.d.). It is highly problematic since the state – as hierarchical superior institution – might declare land in use as being unused land, which entails the danger of land grabbing. In Tanzania, the state is the main agent enacting the discourse of unused land.[2] State projects require a differentiation between legitimate and illegitimate uses, between those that should be discarded and replaced, and others, which should be furthered and expanded. The rationality for this type of distinction is not specifically profit, but state revenue in particular.

The notion of marginal land, on the other hand, is rather applied within international discourses on biofuels and agricultural investment, and by the main institutions of these discourses such as the World Bank (2010), the FAO (Maltsoglou and Khwaja, 2010) or

[1] This is especially the case in regard of *Jatropha curcas*, as suggested for instance by Maltsoglou and Khwaja (2010), though it is also warned that "evidence for the long-term viability of jatropha is largely absent" (Maltsoglou and Khwaja, 2010: 16; see also literature cited in Romijn and Caniëls, 2010).

[2] This is not to say that the term "unused land" is not used by private investors or within the biofuel discourse. However, the narrative of marginal land is closely coupled with private investment in biofuels, at least concerning Tanzania (Widengård, 2011).

biofuel interest groups (Widengård, 2011). It is not so strongly coupled with whether or not the state is legitimized to claim land, but rather serves a capitalist-economic paradigm often operating with the help of land use maps and models, which assumes considerable potentials for enlarging biofuel production without hampering local users and food security.

Marginal and unused land should thus be recognized as social constructs with specific implications and discursive backgrounds. The fact that they are sometimes used interchangeably seems to enhance their attractiveness especially in the biofuel discourse, precisely because they evoke a certain range of mental images and can thus be interpreted rather freely, suiting the interests of various actors. Nevertheless, the impact on the ground is still different to a degree. Land grabbing by the Tanzanian state in the name of nature conservation declares affected land to be unused or that it should be unused. It thus takes on a different form and justification than land grabbing or agricultural investment for the sake of biofuel production as discussed by e.g. the World Bank and implemented on the ground by private capitalist enterprises. The latter do not aim at putting land out of (agricultural) use, nor do they necessarily assume, that target land is completely unused. They argue that their mode of use would increase the efficiency and amount of agricultural production. While the general effects on the ground on local populations might be somewhat similar regarding land grabbing by the state or by private investors, in so far as they tend to increase risk and reduce livelihood options, and while within the biofuel discourse, both concepts are applied, it nevertheless seems to be important to provide a scientific outlook on their meaning. Only then science is able to transparently and critically assess justificatory discourses of harmful or even illegal forms of agricultural investment, i.e. land grabbing.

The blending of both terms, which is reflected in the widespread confusion surrounding the precise interpretation of marginal and unused land, might point towards the blending of two originally different rationalities of social domination: capitalist exploitation versus state-bureaucratic control. This process is typical for the neoliberal phase of capitalist development, as the blurring of the distinction between marginal and unused land is a characteristic feature of the biofuel discourse as, for instance, shown by Nalepa and Bauer (2012). This is also true compared to literature on Tanzanian land use history, where "marginal land" did not play a significant role. Yet, this blurring might not only be attributable to the neoliberal transformation of the state and of the working of international capital, but also to the technical requirement to find a proxy value for possible marginal returns of investment in land. Given the global ambitions of many assessments concerning marginal land and despite weak regional data, these usually fall back on using proxies such as estimations of "degraded" or "abandoned" land (Nalepa and Bauer, 2012). In this way, alleged actual or historical uses are interpreted as indicating potential return on capital invested in a certain region or on certain sites.[3]

Fig. 1 illustrates the relation between capitalist and state rationalities as basically distinct rationalities of domination, represented by two axes of an abstract socio-physical space of possibilities for profit production and the generation of state revenue. The two grey boxes delimit the realm of the possible; places with high potential profit are by trend also those of high potential fiscal yield and vice versa. Marginal land is a realm in between, i.e. a medium to low profitability, usually coupled with a modest potential of fiscal yield; a frontier area, from the capitalist point of view. Only the upper right part of the socio-physical space will in most cases count as land in use (as seen from the point of view of the state), i.e. covered by well taxable forms of smallholder production or industrial agriculture, whether state-managed or privately organized. All other places might be classified as "unused", despite actual land uses such as grazing, collecting firewood etc., including marginal land. This is the frontier region as seen from the point of view of the state.

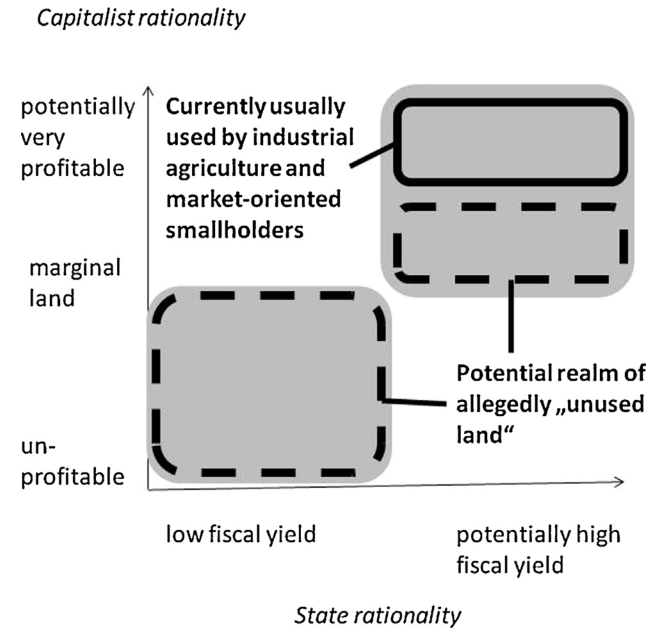

Fig. 1. Relation between capitalist and state rationalities, represented by two axes of an abstract socio-physical space of possibilities for profit production and the generation of state revenue (see explanations in the text).

We can conclude, in a more general sense, that the terms unused and marginal land appear to be only vague concepts with strategic importance for promoting investors and bureaucratic interests. However, the question remains whether unused and marginal land exist to a significant amount in Tanzania to underpin these narratives of unused and marginal land.

Comparing land use data and assessments of unused and marginal land

The first comprehensive study regarding the potential for biofuel production in Tanzania was conducted by the German Development Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit, GTZ, nowadays GIZ) in 2005. Discussing data from the FAO, which indicate that Tanzania has 44.4 million ha potentially available for crop production, the GTZ comes to the conclusion, that "land availability is not likely to be a barrier to bioenergy production in Tanzania" (GTZ, 2005: 61, 101). GTZ repeatedly emphasizes this aspect (GTZ, 2005) and also stresses that large parts of arable land in Tanzania remain unused (GTZ, 2005).

Different sets of data must be available in sufficient quality for such statements to be viable: on the extent of arable land (e.g. for crop production) and on the fraction which is already used. The remaining land which is deemed marginal or unused must subsequently be determined in a transparent way.

[3] Conceptually, "degraded land" is part of marginal land, since the return of investment is seen as marginal in the capitalist-economic view. The Gallagher Review includes degraded land also in its definition of marginal land (Renewable Fuels Agency, 2008: 33, see also above).

Table 1
Land data given by World Bank (1, 2) and Food and Agriculture Organization (3, 4) for Tanzania.

	Area in million ha			
	1	2	3	4
Land area	88.58	93,786	88.58	88.58
Agricultural land	37.30		35.52058	37.30
Reported subcategories of agricultural land				
Permanent crops			1.50586	1.70
Pasture area			24.00518	
Permanent meadows and pastures				24.00
Arable land	11.60		10.00954	11.60
Reported subcategories of arable land				
Temporary crops				9.68**
Fallow land				1.64**
Other land categories				
Terrestrical protected area	24.36		24.54*	
SRNCPF***		8.70		

Sources (13.05.2013): http://databank.worldbank.org/data/home.aspx, World Bank, 2010, http://www.fao.org/docrep/015/i2490e/i2490e00.htm, http://faostat.fao.org/.
1 = World Bank Development Indicators, 2011; 2 = World Bank Landgrab Report, data undated; 3 = FAO Yearbook 2012, various years or undated; 4 = FAOSTAT, 2011.
*2009, **2008, ***suitable for rainfed agriculture but non-cultivated, non-protected and non-forested land with population density of less than 25 persons/km^2.

World Bank and FAO

Table 1 presents several land statistics of Tanzania published by the World Bank and FAO.[4] Haugen (2010) drew attention to the fact that FAO land use categories should be regarded critically. However, Haugen rather contributes to the confusion about part of the FAO land use data by wrongly interpreting the FAO categories "Arable land" and "Agricultural land" as indicating land which could be potentially used for agriculture.

The FAO category "Arable land" considers areas which are actually in use for temporary agricultural crops, temporary meadows for mowing or pasture, land under market-gardens and kitchen gardens, and land temporarily fallow (only including areas, which are idle for less than 5 years; land abandoned in the context of shifting cultivation, which involves longer fallow periods, is not considered at all).[5] The category "Agricultural land", on the other hand, includes permanent crops, land under trees and shrubs producing flowers and permanent meadows and pastures, and includes land which is considered "Arable land" as defined above. "Agricultural land" comprises the size of the area which is actually in use for agricultural purposes, and not the area which could potentially be used in addition. Some of the deviations between values are due to different reference years.

According to FAO and the World Bank, 37.30 million ha are used for agricultural purposes, based on the more inclusive category "Agricultural land", whereas arable land amounts to 11.6 million ha. Table 1 also presents all subcategories of the categories discussed above for those cases in which the FAO reported figures for Tanzania.

The difference between the two subcategories "Permanent meadows and pastures" and "Temporary meadows and pastures" (the latter not reported for Tanzania) is not only that all pastures which are used less than 5 years (before left fallow or changing the type of use) are considered as temporary and those used longer than 5 years as permanent, but that, in addition, only the "permanent"-category includes pastures which are "growing wild".[6] However, it is questionable if grazing land used by pastoralists is reported by states to the FAO, considering the fact that pastoralists and their land uses are often, like in Tanzania, marginalized (Oxfam, 2008).

The 37.30 million ha reported by FAO and World Bank alike as "Agricultural area" for the year 2011, do not consider all areas which are part of shifting cultivation, and completely ignore other non-industrial modes of use, such as for gathering wild food or medicinal plants, firewood, etc. Therefore, the surface actually used for crop production and pastures (including pastoralism) is certainly higher than reported by these international organizations, let alone other uses that contribute to nutrition or subsistence respectively.

So far as so called nature conservation areas express the exclusion of certain uses of land for moral, aesthetic, or touristic issues, land in these cases is instrumental for specific human needs, and, thus, is "used". Indeed, a very important land use type in Tanzania is denoted by the category "Terrestrial protected area", as reported by World Bank Development Indicators and by the FAO Yearbook 2012. With an amount of 24.36 and 24.54 million ha respectively, this area amounts to between 27.5 and 27.7% of the surface of Tanzania. These data are originally based on the World Database on Protected Areas (WDPA).[7]

The sum of 37.30 million ha of "Agricultural land" and 24.54 million ha of "Terrestrial protected area" shows that already at least 67.8% of the surface of Tanzania is used.

To the contrary, data, which explicitly specify the amount of unused land in Tanzania, are difficult to find. However, the World Bank report on the global land grab (World Bank, 2010) uses calculations of the potential for rainfed agriculture, which were done by Fischer and Shah for the report, to indicate the relation between potential and actual use of land for agriculture. For Tanzania, the area considered in the category "suitable non-cultivated, non-protected, and non-forested land with population density of less than 25 persons/km^2" amounts to 8.7 million ha (World Bank, 2010: 166). In general, the World Bank report notes that "[v]ery little, if any, of this land will be free of existing claims that will have to be recognized by any potential investment, even if they are not formalized" (World Bank, 2010: 78f), and argues, without mentioning any source, that "case studies suggest that, at such low levels of population density, voluntary land transfers that make everybody better off are possible" (World Bank, 2010).

A land statistic from FAO, which indicated the size of unused agricultural land in Tanzania, is frequently cited especially by NGOs (for instance actionaid, 2009: 14, 17; Ramadhani, 2007: 10; Maclean and Songela, 2008: 11, see also Haugen, 2010). Details

[4] There is a noticeable deviation in the figures for the land area of Tanzania. However, it seems likely that the World Bank Report actually reports *country area*, which includes inland water bodies and not only solid land area. All percentage values which are given in this paper are based on the latter (i.e. 88.58 million ha).

[5] See the glossary of the FAOSTAT website: http://faostat.fao.org/site/379/default.aspx (02.06.13).

[6] See the glossary of the FAOSTAT website: http://faostat.fao.org/site/379/default.aspx (02.06.13).

[7] http://www.wdpa.org/ (02.06.13).

Table 2
Land data given by the United Republic of Tanzania (URT) in various official documents.

General categories of land	Area in million ha		
	URT 2001	URT 2009	URT 2010
Total land area	95.50	94.50	95.50
Arable land	44.00	44.00	44.00
Rangeland	50.00	50.00	50.00
Tsetse infested area		24.00	
Categories of land uses			
Cultivated land	10.10	9.50	10.56
Land under livestock	24.00	26.00	24.00
Allocation of the used land			
Total land allocated to smallholders		11.90	
Area under medium and large scale farming	1.50	1.50	1.50

about the FAO source in question are often not cited, however, it seems likely that they all refer to an FAO study conducted in 1995 (Alexandros, 1995). This study argues, that Tanzania features 55.2 million ha with "crop production potential" whereby only 10.8 million ha are "currently in use for crop production". The "balance" of 44.4 million ha is therefore potentially available but currently not used for crop production (Alexandros, 1995: 170). Even the GTZ study mentioned above is based on this publication and Makwarimba and Ngowi (2012:10) also indicate that the Tanzanian Government is using these and similar figures, as we will also argue in the next subchapter.

United Republic of Tanzania

Table 2 presents three land statistics used by the government of Tanzania in different official documents.[8] These statistics indicate unambiguously, that arable land in Tanzania amounts to 44 million ha, and that additional 50 million ha can be used as rangeland. However, these data are presented without any definition of the land (use) categories employed, though it seems likely that this area refers to land which can potentially be used. The government of Tanzania states that between 9.50 and 10.56 million ha are already under cultivation and between 24 and 26 million ha are used for grazing livestock. These data are presented without any reference year and their validity can, thus, hardly be assessed.

The reported data of the United Republic of Tanzania includes also the size of the area which is allocated to smallholders or to medium and large scale farming respectively. These data originate from the National Sample Census of Agriculture 2002/03 (URT, 2006b,c). Meanwhile, a National Sample Census of Agriculture 2007/08 (URT, 2012a,b) has been released. The Census gives figures on different land use categories. However, if all figures which indicate any kind of crop production,[9] whether it is conducted by smallholders or by large farms, were put together, 10.06 million ha for the agricultural year 2002/03 and 12.41 million ha for the agricultural year 2007/08 respectively, are under cultivation. These figures of the agricultural year 2002/03 are quite close to those

[8] The category "total land area" obviously again refers to the country area, which includes – as compared to the category "land area" – inland water bodies.

[9] All categories which identify, according to the definition (URT, 2006a), any kind of crop production were considered here: "Area under Temporary Mono Crops & Mixed Crops", "Area under Permanent Mono Crops & Mixed Crops", "Area under Permanent/Annual Mix", "Area under Permanent/Pasture Mix", "Area under Fallow" and "Area under Planted Trees". "Area under Permanent/Pasture Mix" includes permanent crops like oranges but also pastures. Yet we include this mix-category in our category crop production. "Area under Fallow" is also included in this category because this area is allocated for crop production even though it might not be used in the specific year of the Agricultural Census.

Table 3
The cultivated area in Tanzania based on LANDSAT images.

	Area in million ha
Cultivation with herbaceous crops	2.19
Mixed cropping	6.32
Cultivation with bush crops	0.09
Cultivation with tree crops	0.14
Cultivation with shade trees	0.11
Sum (cultivated area by a narrow definition)	8.85
Grassland with scattered cropland	4.70
Bushland with scattered cultivation	9.23
Woodland with scattered cropland	6.99
Total sum (cultivated area by a broad definition)	29.79

Source: Yanda and Shishira (1999).

of the category "Cultivated area" as indicated by the Tanzanian government elsewhere and presented in Table 2. However, the agricultural census of 2007/08 reports an increase of the land under crop production. If this latest figures of 1241 million ha is taken as the area under cultivation and combined with the figure of 26 million ha (as the area under pasture, as presented in Table 2), the area which is under crop production and under pasture in Tanzania amounts in total to 36.41 million ha. This figure is quite close to the agricultural area reported by FAO and the World Bank (37.30 million ha, see above), whereby both mentioned land categories include crop production, fallows and pastures.[10] The figures of FAO and the Tanzanian government for the area which is under pasture are similar. However, in neither case it is known whether they include areas which are used by pastoralists. Additionally, the figure reported by the government refers to the agricultural year 2007/08, the FAO and World Bank data to the year 2011.

The National Sample Census of Agriculture also gives figures on the categories "Area Unusable" and "Area of Uncultivated Area but Usable Land". However, since the National Census of Agriculture only considers land which "the household has sole access to" (URT, 2012a: 479, emphasis by the authors), these figures are not applicable to indicate the total area of unused or marginal land within Tanzania.

Results of remote sensing

In the following we will present land statistics based on remote sensing techniques. Yanda and Shishira (1999) published a list of areas per land cover type based on LANDSAT images from 1994/95 (see Table 3). The total cultivated area in the mid-1990s amounted, according to the authors, to a figure of between 8.9 and 29.8 million ha, depending on the percentage of agriculturally used land per land cover type. The category "total cultivated land" of the table in the annex of Dallu (2003) only subsumes "Mixed cropping", "Cultivation with tree crops", "Cultivation with tree crops (with shade trees)", "Cultivation with bushy crops", and "Cultivation with herbaceous crops", and accordingly omits the other land cover types of more or less natural vegetation (grass-, bush- and woodland) with scattered cultivation, which has been used in Yanda and Shishira (1999) (see Table 3). The sum of these types amounts to 10.14 million ha. According to Dallu (2003), the category "Woodland with scattered cropland" (6.9 million ha) can be interpreted as the realm of shifting cultivation. However, it should be noted that shifting cultivation presumably involves larger areas – which is not discussed by Dallu (2003).

Hannerz and Lotsch (2006) compared several sources of remotely sensed with statistical land use data on agricultural land

[10] As already mentioned above, the FAO does not include areas, which are more than 5 years under fallow, in their respective category ("fallow"). The definition of "fallow" of the National Agricultural Census is not clear on this point (URT, 2006a).

Table 4
Different remotely sensed data of the agricultural area of Tanzania.

	Area in million ha
MODIS (2000–2001)[a]	3.79
GLC2000 (1999–2000)[a]	22.70
Landscan (1992–1993)[a]	18.51
IFPRI (1992–1993)[a]	31.44
SAGE (1992–1993)[b]	12.16
GLCF (1981–1994)[a]	6.02

Source: Hannerz and Lotsch, 2006 (the time frame of the data is indicated in brackets).
[a] 1 km resolution.
[b] 5 km resolution.

Table 5
Tanzania extension of the eight major FAO Land Cover Classification System classes. The hectare percentage is calculated on the total area of Tanzania.

Land cover	Land cover class name	Million ha	%
AG	Agriculture	32.1	33.1
BA	Bare Areas	0.1	0.1
NVT	Natural vegetation	49.8	51.5
NVW	Natural vegetation regularly flooded	7.3	7.6
UR	Urban	0.1	0.1
WAT	Water	7.4	7.6
Total		96.9	100

in Africa.[11] The discrepancies are considerable and have crucial consequences for the reliability of analyses based on the data. Remote sensing methods show a weak performance if based on data in heterogeneous landscapes, which are typical for regions with shifting cultivation, as it is widespread in Tanzania. However, the authors also point out that data from statistical studies are to be interpreted with great caution (Hannerz and Lotsch, 2006: 12f.).

Table 4 shows the range of six remotely sensed data points concerning the share of agriculturally used areas in Tanzania. The variation in the data is quite high. Interestingly, with 37.30 million ha, the FAO figure for the category "Agricultural land" for the year 2011 (see above, Table 1) is higher than any of the estimates based on remote sensing.[12] On the global and regional scale, Wood et al. (2000) came to the same conclusion and state for the case of the IFPRI data:

> "There are at least two sources of discrepancy. The first is the under reporting of agricultural area by satellite remote sensing because of both the failure to detect agricultural crops and pasture that are similar to natural forests, woodlands, and grassland, and the limitation of not identifying agriculture when it occupies less than 30 percent of a land cover class." (Wood et al., 2000: 20).

Moreover, remote sensing data are also dependent on the season; if measurements take place during the time when the land is barren (i.e. late dry season) the indicated area under cultivation will be smaller than during the growing season. In the land assessment for Sun Biofuels in Kisarawe, for instance, the measurements were apparently done deliberately in a season that would yield to minimum existing crop values, thus leading to minimum values for compensation to be paid for the local land users (Bergius, 2012).

A further note shall be added on the spatial resolution used to capture remote sensing data. The resolution of the sensor applied by the different spaceborne platforms differs in one case (see Table 4, SAGE dataset). However, the dimension of the treated figure (millions of ha) and the large difference between the SAGE dataset and the other ones, allows to confidentially state that the agricultural area reported by the different remote sensing datasets (Table 4) are significantly different.

In general, substantial uncertainties in remote sensing land use data are confirmed by Ge et al. (2007). Soil data in East Africa are "poorly mapped", as the authors note, emphasizing that the best land use data available for Tanzania remained under a threshold of 85% accuracy.

Africover

The following tables summarize the extents of different land cover classes from the Tanzanian Africover dataset classified according to the FAO/UNEP Land Cover Classification System (LCCS). The system adopts a flexible approach that uses a set of hierarchically arrayed classifiers which can be assembled to meet user needs and local land use peculiarities. The coarser LCCS classification is based on eight major classifiers (land cover classes): (1) cultivated and managed terrestrial areas, (2) natural or semi-natural terrestrial vegetation, (3) natural or semi-natural aquatic vegetation, (4) cultivated aquatic or regularly flooded areas, (5) artificial surfaces and associated area(s), (6) bare area(s), (7) natural and artificial water bodies, (8) snow and ice. The base data for the classification applied within the Africover project were remote sensing images covering the whole African continent, specifically, the Tanzanian dataset was produced by FAO by visual interpretation of LANDSAT (Bands 4, 3, 2) imagery mostly acquired in 1997.

Table 5 summarizes the areas of the eight major land cover classes of the FAO/UNEP LCCS. Yet, only six out of eight classes are listed in the table, because category 1 (Cultivated and managed terrestrial areas) and 4 (Cultivated aquatic or regularly flooded areas) are merged, while category 8 (Snow and ice) is left out. During data handling, it emerged an erroneous classification of a negligible (0.4%) part of the dataset, that was found to be classified as null.

Land cover classes NVT (natural vegetation) and NVW (natural vegetation regularly flooded) can be considered as the area potentially suitable for agriculture in the broadest sense; their sum is 57.1 million ha. The computation does include the areas currently allocated as nature conservation areas. At the same time, the term "potentially suitable" shall be considered with caution; the computation accounts only for land cover and does not include other factors that are relevant to the definition of suitable agricultural land. Such factors encompass for example land accessibility, annual rainfall, soil fertility, slope, temperature etc. The first two factors might be of particular importance in the Tanzanian context where the transportation infrastructure is rather under-developed, fuel cost relatively high and water availability a consistent limiting factor. Yet, land cover classification does not allow assuming that land currently not used for agriculture, although "potentially suitable" is actually not used for other purposes, i.e. wood collection or cultural practices. Assuming that the figure of 57.1 million ha is in general correct but has to be considerably downgraded due to the factors mentioned above. Consequently, the figure depicted by the GTZ (2005) (see above) as potentially available for crop production (44.4 million ha) appears to be quite optimistic, since the extent of protected areas within Tanzania is already considerable (see Table 1).

In respect to the data in Table 1 the Africover estimate of the land cover class "Agriculture" is 3–4 million ha short, hence quite

[11] Only cropland was assessed. However, the definitions of cropland by several of the sources that are cited seem to contain potential or actual pastureland. In one source, this is explicitly stated so.
[12] Hannerz and Lotsch (2006: 152) report for FAOSTAT 5 million ha with the reference year 2000.

in accordance with the WB and FAO datasets.[13] The same degree of similarity can be found in respect to the United Republic of Tanzania (URT) data, where a combination of the latest National Agricultural Census data on cultivated land and the reported figure on "Land under livestock" results in 36.41 million ha of agricultural area (see chapter 3.2). Finally, the comparison with the dataset from Yanda and Shishira (1999) (Table 4) again shows a figure of agricultural extension rather similar to the Africover dataset, while when comparing the results from different remote sensing datasets (Table 4), only the highest estimate (IFPRI dataset) is comparable to Africover.

Assessments of marginal land for biofuel production

Cai et al. (2011) recently mapped the "marginal agricultural land" on a global level potentially available for biofuel production, with "marginal" in the sense of low productivity on different land cover types, yet sufficient for the cultivation of energy crops for fuel. The conversion of forested areas into cropland for energy plants was not considered. From their definition of marginal land and based on their choice of land cover types, potentially cultivated areas were not meant to be included. Furthermore, under all scenarios, it was assumed that the energy crops would be rain fed. Protected areas were not excluded. A sensitivity analysis of the results of their deterministic model is not reported. The global estimates ranged from 320 to 1411 million ha across four scenarios.

Cai et al. (2011) generated a global productivity layer, integrating soil productivity, slope, soil temperature and humidity (mostly from coarse resolution globally available biosphere data) to determine the productivity probability of a given area (three classes: marginal, low or regular productivity). This layer was then combined with the IGBP (International Geosphere-Biosphere Programme) land cover map to determine the areas of marginal productivity on certain land cover types, i.e. croplands, shrublands and grasslands based on four different scenarios.

In Scenario 1 (S1), only marginal land in the mixed crop and natural vegetation class of the IGBP map was selected, resulting in a global estimate of 320 million ha. Scenario 2 (S2) additionally considered the cropland class of marginal productivity, which increased the available land to 702 million ha. In Scenario 3 (S3), marginal shrubland, savanna and grassland classes were added to produce a figure of 1411 million ha. Yet, this approach would lead to an overestimation, as these land cover types could be used for pastureland. Therefore, the authors added a fourth scenario (S4), in which pasturelands were removed from the calculation using a data set from FAO. This revised the estimate downwards to 1107 million ha of land available for biofuel production.

In a recent paper by Fritz et al. (2013), the four land availability maps of Cai et al. (2011) were evaluated with respect to land cover. Additionally, human impact was explicitly introduced to make sure to exclude land already in use. The Geo-Wiki (Fritz et al., 2009, 2012) was used to collect the data using crowdsourcing from Google Earth high resolution satellite imagery. The modelled productivity in Cai et al. (2011) was not tested.

The assessment led to downgraded estimates of potentially available land for biofuel production. At a global scale the decrease amounts to a reduction of at least 60% in each of the scenarios, if both land cover and reduction by human impact are considered. The crowd was generally composed of experts and students in remote sensing and spatial sciences but no local knowledge or agricultural background was required to participate.

Areas (of 1 km^2 pixels from Google Earth satellite images) were randomly sampled from the four land availability maps. Volunteers were asked to determine the land cover and the degree of human impact visible in each area. Around 18,000 pixels were used where 299 were control pixels, independently assessed by three experts, and used to assess the quality of the crowdsourced data. The estimates of land availability for each scenario were also bias corrected.

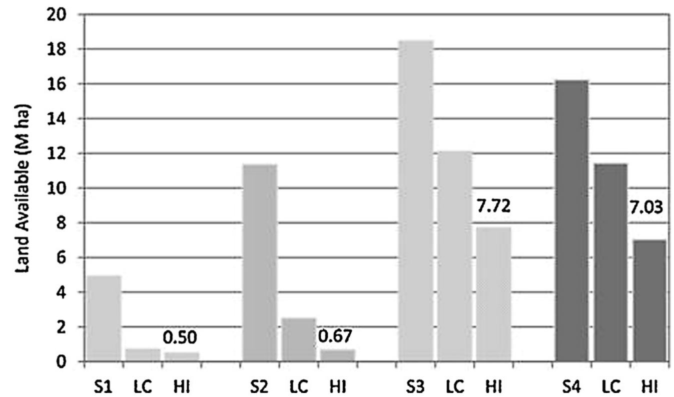

Fig. 2. Land available for biofuel production in million hectares (M ha) in Tanzania according to Cai et al. (2011) for scenarios S1–S4 and the results after adjustment by land cover (LC) and human impact (HI).
First column: data from Cai et al. (2011); other: Fritz et al. (2013) previously unpublished, without bias correction contrary to Fritz et al. (2013).

Firstly, by determining the percentage of land cover types present in each of the four maps, the estimates were adjusted downwards. For example, S1 of Cai et al. (2011) considered land classified as a mosaic of cropland and natural vegetation. Fritz et al. (2013) found only 35% of this land cover type present in the sample and the value of 320 million ha was subsequently downgraded to 113 million ha. A further adjustment was made for the degree of human impact visible in the pixel. For instance, if a pixel was designated 20% human impact, then only 80% of the pixel area were counted as available for biofuel production. For S1, this further downgrading resulted in a final estimate of 56 million ha.

In order to assess the "marginal agricultural land" potentially available for biofuel production for Tanzania, additional data from two subsequent crowdsourcing campaigns were used, where volunteers assigned the percentage share of different land cover classes in each area,[14] thus leading to an improvement in the data obtained compared to those published for the global evaluation in Fritz et al. (2013). The estimates of land availability based on Cai et al. (2011) for S1–S4 are provided in Fig. 2, ranging roughly from 5 to 18.5 million ha in Tanzania. These values were then adjusted in the same way as undertaken by Fritz et al. (2013) for both land cover and human impact. For land cover, the values range between 0.7 and 12.3 million ha while further adjustments for human impact resulted in values ranging from 0.5 to 7.7 million ha for S1–S4.

Whether the modelled productivity for the chosen sites in Cai et al. (2011), and subsequently in Fritz et al. (2013), is biophysically appropriate for the cultivation of biofuel plants still remains to be assessed, let alone the economic feasibility.

Comparing the results from Cai et al. (2011) and subsequently Fritz et al. (2013) to the figures published in the World Bank Report on the global land grab (World Bank, 2010), in which the potential for rain fed agriculture was modelled,[15] a considerable correspondence can be determined. The area of land deemed unused, the figure of 8.7 million ha from the World Bank report comes close

[13] However, it seems that Africover does not account for fallows, in contrast to the WB and FAO dataset.

[14] Originally only a single dominant land cover type visible from the satellite image was assigned to the pixel.

[15] Including "suitable non-cultivated, non-protected, and non-forested land with population density of less than 25 persons/km^2" and, thus, to a certain extent similar to Cai et al. (2011) and subsequently to Fritz et al. (2013).

to 7.7 million ha of the presumably most similar scenario 3, after correction for land cover and adjustment for human impact in Fritz et al. (2013). In S3, the probable pasture land is explicitly not excluded, which seems to correspond to the setting in the World Bank report.

However, as Fritz et al. (2013) clearly state, their results "should not be considered as definitive estimates, but should be used to highlight the uncertainty in attempting to quantify land availability for biofuel production" (Fritz et al., 2013), especially when raw data of low quality are employed.

Moreover, the data provided by Fritz et al. (2013) is based on an assessment of land cover carried out by human beings, guided to assess discernable human influence in the satellite images. In contrast to mere algorithmic methods, this approach can be considered an appreciable improvement compared to other studies. Nevertheless, it would be meaningful to ensure that participants have specific agricultural and local knowledge (at least at the level of the respective state).

Critical analysis of figures on used and marginal land

As the previous chapter already indicated, hardly any specific data exists on unused land in Tanzania, while, on the contrary, various statistics and data from remote sensing provide information on land, which is, for example, already being used for agriculture purposes (i.e. cultivation and grazing). Surprisingly, statistical data on the agricultural area of Tanzania are quite similar across different sources presented above. The FAO and the World Bank published the highest figures on Tanzania for this category, which amount to 37.30 million ha. A summary of different figures, provided by the Tanzanian government, results in a similar picture (36.41 million ha). Data generated though remote sensing varying between 3.79 million ha (MODIS) and 32.1 million ha (Africover), whereby the data of Africover gives a picture of the agricultural area in Tanzania similar to that reported in statistical data. However, land use types other than cultivated and pasture areas have to be considered to indicate areas already in use. This includes at least forest use, protected and settlement areas. Moreover, there exist various uncertainties regarding the amount of pasture areas used by pastoralists.

Temporal patterns of use constitute a considerable factor of uncertainty concerning the estimation of the land used for agriculture. Shifting cultivation plays an important role in Tanzania, as also government sources state.[16] Cotula et al. (2009) estimate, that an average of five plots are under fallow for each plot used in shifting cultivation schemes in Africa. According to Siebert et al. (2010), the share of fallows can even be higher in dry regions. Several case studies on Tanzania (Allen, 1965; Luoga et al., 2000; Nduwamungu et al., 2008; Mwampamba, 2009; Mangora, 2005; Grogan et al., 2013) indicate, that shifting cultivation was of substantial importance in Tanzania, and suggest that it is still widely practiced, but that fallow times have been very much reduced. Raikes states that a sustainable fallowing system "will involve a cycle of at least ten and up to thirty years" (Raikes, 1986: 111). Contemporary fallow lengths show considerable variation as reported in case studies (Malley et al., 2006; Southwestern Tanzania: 2 years; Mangora, 2005; Uramba district: 4 years; Mwampamba and Schwartz, 2011; Eastern Arc Mountains: 0–56 years).

The FAO figures of arable land and agricultural land, including short-term fallows, in any 1 year, are the highest of all available figures and might be regarded as the minimum of the surface area actually affected by this type of use. Given the fact, that FAO figures rely on estimates by local authorities, who hardly have the resources to make surveys or do mappings, and are probably affected by a bias against "unproductive" smallholder agriculture and shifting cultivation, one should rather expect it to be a considerable underestimation. FAO food production figures are, for example, known to be not based on independent measurements, but are inferred from crop acreages estimated by local authorities, taking into account precipitation patterns and fertilizer use. Since the portion of marketed crops in Tanzania represents only a fraction of the total production, and most of the marketed crops are beyond the reach of conventional statistical data gathering, production figures are very unreliable (Meertens, 2000; Oya, 2010). Recent estimates state, that at least one fourth of the agricultural produce does not reach any market (Delgado et al., 2004). Thus, one might expect FAO figures on crop production surfaces to underestimate cropland considerably.

Pastoralism is another blind spot in statistics regarding land use types. Fritz pointed out, that in most land statistics, pastoralist areas are not included in the category of used land, even though 25% of the global land area is used by pastoralists who practice extensive livestock farming, thereby contributing to food security and the conservation of the ecosystem (Fritz, 2010). Yet, also in the case of Tanzania, pastoralism is of considerable importance in Tanzania, especially in semiarid regions (Oxfam, 2008). However, an official assessment of the geographical extent of pastoralist use is lacking until today. According to estimates, about 4 million people (ca. 10% of Tanzania's population) depend on pastoralist practices (Oxfam, 2008: 8). About 99% of the 33.7 million cattle in Tanzania is tended by pastoralists, as estimated by Oxfam (2008), and only about 1% is kept on European-style farm homesteads and ranches. About 90% of the fodder is from grasslands (Sarwatt and Mollel, 2000). The National Sample Census of Agriculture from 2007/08 counts 21.3 million cattle in Tanzania, 15.2 million goats and 5.7 million sheep (URT, 2012c).

About 30–60% of Tanzania's surface are, varying by definitions, arid regions mainly used by pastoralists (Oxfam, 2008: 8). According to the study of Sarwatt and Mollel (2000), which is based on figures from 1978, 43.879 million ha of grazing land exist in Tanzania, including a small surface covered by cultivated grasslands. However, the authors state that not the whole area is available for grazing at any one time, since the patterns of use obviously depend on variable ecological conditions, ranging from tsetse fly infestation to seasonal cycles of drought.

The study published by Sarwatt and Mollel (2000) appears to be the most detailed on the biophysical aspects of Tanzania's livestock sector up to today. It seems to be significant, that this study, however, does not indicate a figure for pastureland actually in use, but states the range of grazing lands on the one hand, and the potential maximum livestock on the other. This potential stock is estimated on the assumptive basis of an average surface requirement of more than 4 ha per head of livestock (animal units) in the arid zone, of 2–4 ha in the semiarid zone, 1–3 ha in the dry to subhumid zone and 0.5–2 ha in the humid zone. Sarwatt and Mollel (2000) thus estimate a potential maximum livestock in Tanzania of about 20 million head (in animal units). Given the fact, that this number is superseded by actual livestock numbers (see above), and that the majority of livestock still depends on grazing lands, one might conclude that all grazing lands i.e. 43,879 million ha are in use.

However, such an estimate needs to be formed cautiously, not least due to the critique of the concept of carrying capacity and how it is applied in subtropical Africa (Vetter, 2004). In particular, it does not account for seasonal mobility of pastoralists which is, however, a key strategy to cope with unpredictable range forage availability in terms of time and space within semiarid environments (Scoones, 1994). Moreover, it should be emphasized, that

[16] See e.g. http://www.tanzania.go.tz/agriculture.html (27.05.13); description of farming systems.

especially the access to dry season grazing reserves are most important for pastoral systems. Those grazing reserves, which are set aside for the use during the dry season only, sustain the livestock during this hard season. This is due to the fact that water is for instance also available during the dry season in such areas (Bartels, 2013).

Remote sensing as an exclusive method appears not suitable to detect the full extent of pastoralist types of land use. Also mapping based on field surveys, done on the ground or by plane, is prone to errors, because pastoralism is characterized by a varying degree of flexibility and dynamics. As McGahey argues, assessment of pastoralist land uses is only possible by asking users themselves (McGahey, 2008). This, of course, is both time consuming and costly.

Besides pastoralism and agriculture, also forest use is important in Tanzania. The World Bank estimates, that 75% of all construction materials, 95% of all energy used by households and 100% of all traditional medicines are gained from forests (World Bank, 2008; cit. in Sulle and Nelson, 2009: 46). An extensive description of the diversity of forest use beyond timber production, including the production of honey as a crucial aspect, is given by the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism of Tanzania (1999).

In any case, the simple arithmetics of the country wide population to land ratio do not give reason for optimism concerning unused land. If the country's land area of about 88.5 million ha is divided by the total population of 44.9 million in 2012 (URT, 2013), less than 2 ha are available per individual on average.[17] This rough estimation, however, disregards that about 35.2 million ha are covered by forests and 4.7 million ha with other wooded land, according to current FAO statistics.[18] An unknown portion of these surfaces is most probably part of shifting cultivation systems or used for collecting wild plants and thus of the total land requirements of agriculture and other modes of food production. They are also probably part of grazing systems to an unknown extent. However, subtracting about 39 million ha of wooded land from the total land area leaves 49.5 million ha of land, which could be directly used in some form or the other for food production (grain, vegetables, animal products) in 1 year. This calculation results in ca. 1 ha per person to satisfy the most basic needs of life, yet disregarding the land used for nature conservation. For a country, which cannot count on "importing surface" in terms of animal fodder, food, energy carriers and building materials, and which is characterized by vast areas of land with low productivity due to natural factors such as variable or low rainfall, which will become probably more problematic in the course of climate change, and regardless of technology, this amount of land offers very limited options for additional uses such as biofuel production, especially if it is for export.

Unfortunately, specific actors can easily make use of the "unused land argument", as long as at least one figure is available, which supports this argument. In the case of Tanzania the outdated FAO study conducted in 1995 (Alexandros, 1995), replicated by the former GTZ (2005) (see chapter 3) and others (actionaid, 2009; Maclean and Songela, 2008; see also Haugen, 2010), appears to serve the creation of such a figure. Interestingly, besides the claims, we could hardly find any figures on marginal land in Tanzania. The assessment of Fritz et al. (2013, see also above) has shown, how uncertain the assessment of marginal land is. Moreover, figures of unused and those of marginal land are often used without reflecting the process of state simplification behind them. This can be seen in the process of excluding certain uses from statistics of unused land that is not transparent. In a similar vein, Fritz et al. (2013) also note, by referring to the Cai et al. (2011) study on marginal land potentially available for biofuel production, that the biofuel lobby tends to cite the upper rather than the lower bound of the given range. To date, the figures published herein are the only ones referring to "marginal" land at least in a broad sense, by downscaling the results of Cai et al. (2011) to the case of Tanzania, due to a lack of other, better data. Remarkably, they are quite close to the data on "unused" land provided by the World Bank. However, it should be noted, that a viable approach to assess "marginal" land – within the meaning that is accounted for in this paper –, would entail a set of specifications, data and calculations, that would necessitate more in-depth studies as are at hand at the moment.

Discussion and conclusions

The making of unused and marginal land: state simplification at work

Land use is intimately interweaved with social relations and cannot be detached from them (Borras and Franco, 2010). These relations are today usually characterized by inequality and one-sided domination, thus making land use the terrain of struggle over access to land, the distribution of its produce and the income that can be gained from its sale. Thus assessing land use is far from being a technical issue of apparent neutrality. Quite to the contrary, assessment primarily means valuation, and this is in turn based on a specific rationality.

James Scott discussed the normative aspect of land use assessments in depth and put it in a historical context of increasing state legibility of social relations and the relations of society with nature (Scott, 1998). Land use assessments are basically state projects; important ones, strategically. Such endeavours are directly undertaken or promoted by state bureaucracy. For the state, land use assessments serve to increase or – in the first place – enable tax revenue by preceding the commodification of land or legitimizing it in retrospect, including revenue from taxes tagged to landed property, or to enterprises or peasants using the land.

These projects of enhancing state legibility are social constructions in the most power-soaked sense, because the eyes of the state are not able to detect a social order which is essentially self-organized without a political institution separated from it, as is the state. Thus, state legibility requires a process of making the object that should be deciphered readable in the first place. The most important technique to achieve this is simplification. Simplification creates the environment as much as it filters, reinterprets and rearranges some of its characteristics.

Scott's historical examples are mainly concerned with land tenure, outlining the forced transformation from communal tenure regimes, which were complex and fluid, and thus illegible to the state, to private property and cadastral maps, which were legible. The current approaches of detecting "unused" or "marginal" land are based on a simplification process on the level of types of land use – which is not necessarily connected with any specific form of user rights such as communal tenure or individual private property.

In the neoliberal era, this process of simplification is driven by the quest for profit of global capital, and at least supported, often even enforced by the logic of control embodied by the state. Its outcome is probably most glaringly illustrated by a map given by the World Bank's publication on global land grabs, or "agricultural investments", as the Bank prefers to term the issue (World Bank, 2010). This map translates every inch of soil on the globe into a monetary value. The almost infinite variety of ecological spaces and the many land use forms attached to it, shaping it, are apparently represented by a single dimension, that is, monetary value. In this process, externalities are created and thus a lot of non-monetary

[17] See also http://farmlandgrab.org/post/view/20120 (27.05.13).

[18] http://www.fao.org/forestry/country/32185/en/tza/ (27.05.13).

"value" is lost, such as its spiritual dimension, or the importance of land per se, and for future generations.

The complexity of land use arrangements and seasonal cycles of subsistence economies are illegible both for the state and for capital. Thus, land use is reframed as a potential monetary value, which should from now on guide state policies and investment decisions. This redefinition of land as abstract economic value equals the paradigmatic role of cadastral maps in the 19th century. In the eyes of an agroscientist working in the mind-frame of capital, this translation boils down to simplify the arrangement of actual and potential land uses to the only dimension relevant to economic growth and profit production. However, it should instead be interpreted as a process of creating a landscape of abstract economic value.

This creation is done on a discursive level in the first place. According to the meta-discourse of agricultural modernization, investment and progress, as it is embodied in the biofuel discourse, state policies should be guided to put this vision of a modernization of land use into practice: firstly by integrating subsistence production into the (world) market; secondly by replacing smallholder by capitalist agriculture, either as large scale monocultures or outgrower schemes; thirdly by evicting e.g. pastoralists who are deemed to be excluded of a natural landscape that should be protected from them to yield foreign exchange income. This is the strategic point where uses which do not come close to the monetary value assigned to a specific place are excluded from further consideration by the neoliberal state.

Investigating into the discrepancies between official land use data and the probable extent of different types of land use allows to draw several conclusions. First and foremost, we showed that the vague use of unused and marginal land as interchangeable terms cannot be accounted to mere imprecision. Both narratives turned out to be social constructs, which serve specific economic and political interests. We argued that the notion of "marginal land" serves a capitalist-economic rationality, while the term "unused land" is more related to a state-bureaucratic rationality.

In general, both narratives are an expression of state simplification processes on the level of types of land uses and, thus, of users. Our focus on available data concerning land uses in Tanzania identifies particularly pastoralists as the bereaved of both rationalities: the capitalist-economic rationality excludes pastoralists, because they usually do not produce profit but rather products for subsistence or a certain market-income to support their livelihoods; the state-bureaucratic rationality excludes pastoralists, because they are mobile, and thus rather autonomous, not easily to be captured as state subjects, and so neither easy to tax nor to coerce into national development aspirations. Taking a broader historical perspective, nature conservation is the main driver for land grabbing in Tanzania rather than agricultural investment including biofuel production, contrary to the impression that the current discourse of land grabbing may give. Pastoralists are thus the main group of persons concerned by land grabbing since most of the areas designated as conservation area were former pasture land[19] (see case studies: Benjaminsen et al., 2011; Ngoitiko et al., 2010; Igoe and Croucher, 2007; Brockington, 1999).

In addition to pastoralism we also discovered that shifting cultivation is not or only inadequately covered in the various statistics discussed above. Fallows, which are a necessary part of shifting cultivation, can easily be classified as abandoned or unused land; the longer a fallow lasts, the easier this can be the case. Furthermore, shifting cultivation is not as productive per unit of land as intensive fertilizer-based cultivation, because the latter does not rely on fallows. This disadvantage in land productivity might be a reason for not or only inadequately including shifting cultivation in land use statistics.

It can be concluded that, for the case of pastoralism and from the point of view of investing agro-capital (targeting biofuel or staple food production), marginal land largely overlaps with a state-centred view of unused land. The practice of pastoralism contradicts deeply entrenched ideas of modernization and national development beyond the mere investment requirements of capital.

Remote sensing as the contemporary form of state simplification of land use

While the assessment bias could be remedied partly, for example by using more suitable raw data and crowdsourcing, such as in Fritz et al. (2013) and by land use statistics changed to a more realistic and socially balanced content, the way of viewing the landscape top down – compared with earlier techniques of state simplification, such as the production of cadastral maps even literally – remains a bias in itself.

This top-down-view can be kept track of at different levels: physically, because satellite images are used as base data. Furthermore, by asking the question, where the attributive information to the features on the images originate from, i.e. the necessary special information about land use? Peasants, pastoralists, remote sensing experts, postgraduate students or scientists? On the other side, peasant and pastoralist producers construct their landscapes from the bottom-up, i.e. in the very contexts of their lives, out of their specific social position. This position is essentially different from that of members of the state bureaucracy, the political elite or capitalists and makes a top-down view, even if it is balanced by crowd sourcing of land use data, rather irrelevant to their perspectives and potentials of organizing land use.

Robbins (2003) has shown in detail, how land might be seen in different ways and how land classification entails decisions which are highly context-dependent. In his case study on a region in India, local peasants, forest managers and ecologists produce three different land cover classifications – with implications for land use types. None of them is true in an absolute sense. They rather reflect different social positions, interests and daily practices.

Thus, the process of land cover classification is basically constructivist and involves the production of biased knowledge by simplification (and, thus, by generalization). Furthermore, the outcomes are not interpreted in a value-free social space characterized by social equality. In fact, they meet a contested terrain of political debate, structured by asymmetrical power resources, ranging from capitalist interests and attempts to increase state control over society to social struggles for food sovereignty and the autonomy of migration. This is supported by Robbins in his investigation of GIS and its use in ecological modelling and landscape management (Robbins, 2003: 236).

Hence, the seemingly general view of remote sensing and land use experts turns out to be a particular view fostering partial interests. The particular nature of this view lies in its inherent top-down-perspective and its very generality, which is achieved by ignoring local understandings of land use, and – until fairly recently – its exclusivity. These techniques and methods indeed also fit the general neoliberal rationality of increasingly growing efficiency and control. Thus, GIS approaches are exceptionally applicable and attractive for supporting and implementing processes of state simplification. That GIS are, for the most part, still applied as a top-down technology (which is especially clear in the context of land grabbing), despite two decades of critical research

[19] Accordingly, the amount of pastoralist grazing land is the most controversial aspect of land use data besides non-agricultural uses, such as wild plant collecting. The latter are not statistically registered or estimated at all, since they are not legible to the state, cannot easily be taxed and do not fit into ideas of national development fixed on industrialization in agriculture and beyond.

into GIS that has developed alternative uses of the technology (e.g. Kwan, 2002; Robbins, 2003), underpins that GIS lend themselves to projects of a certain kind, i.e. those pushed by the state and global capital, more than to others, which are created from the bottom-up.

Remote sensing and GIS analyses are not erroneous as a technique, if properly applied, which is not always done today in the area of modelling biofuel potentials. However, attributable to their inherent features and opportunities, these technologies fit those actors attempting to "see like a state" well, and might have a certain value for a mode of organizing and improving land use that starts from the capabilities and desires of actual land users only when participatory methods are employed and their goals can be decided upon by the actual users themselves.

Acknowledgments

The authors thank the Climate and Energy Fund of the Austrian Federal Government, which made this research possible in the frame of the project "Save our Surface" (grant number 822028, 2nd call of Neue Energien 2020). We thank Janet Marot for feedback on former versions of the paper and two anonymous reviewers for helpful comments and suggestions that considerably improved a former version.

References

actionaid (Ed.), 2009. Implication of Biofuels Production on Food Security in Tanzania. , http://xa.yimg.com/kq/groups/20674633/1230321024/name/Implication+of+biofuels+production+on+food+security+in+Tanzania.pdf (27.07.07).

Alexandros, N., 1995. In: FAO (Ed.), World Agriculture: Towards 2010. An FAO Study. John Wiley & Sons Ltd., Chichester.

Allen, W., 1965. The African Husbandman. Oliver & Boyd, Edinburgh, London.

Altvater, E., Geiger, M., 2010. Teilbericht 2: Weltwirtschaftliche Kausal- und Trendanalyse Der Wandel des Energieregimes und die weltwirtschaftliche Entwicklung. Studie "Save our Surface" im Auftrag des Österreichischen Klima- und Energiefonds, http://www.umweltbuero-klagenfurt.at/sos/wp-content/uploads/Teilbericht%202_SOS_Altvater-Geiger_12012011.pdf (14.07.14).

Bartels, L.B., 2013. Socio-Ecological Impacts of Land Grabbing for Nature Conservation on a Pastoral Community: A HANPP-based Case Study in Ololosokwan Village, Northern Tanzania, http://www.uni-klu.ac.at/socec/downloads/WP149_webversion.pdf (27.04.14).

Benjaminsen, T.A., Bryceson, I., Maganga, F., Refseth, T., 2011. Conservation and Landgrabbing in Tanzania. In: Paper presented at the International Conference on Global Land, *Grabbing*, 6–8 April 2011. Institute of Development Studies, University of Sussex. http://www.iss.nl/fileadmin/ASSETS/iss/Documents/Conference_papers/LDPI/20_Tor_A._Benjaminsen_-_Ian_Bryceson_-_Faustin_Maganga_-_Tonje_Refseth.pdf (14.07.14).

Bergius, M., 2012. Large scale agro investments for biofuel production in Tanzania. Impacts on rural households. Institute of Development Studies, University of Agder, Norway (5/31/2012).

Borras Jr., S.M., Franco, J., 2010. Towards a broader view of the politics of global land grab: rethinking land issues, reframing resistance. In: ICAS Working Paper Series No. 001.

Brockington, D., 1999. Conservation, displacement and livelihoods. The consequences of the eviction for pastoralists moved from the Mkomazi Game Reserve, Tanzania. No-madic People 3 (2), 74–96.

Cai, X., Zhang, X., Wang, D., 2011. Land availability for biofuel production. Environ. Sci. Technol. 45, 334–339.

Cotula, L., Dyer, N., Vermeulen, S., 2008. Fuelling exclusion? The biofuels Boom and Poor People's Access to Land. FAO, IIED, http://pubs.iied.org/pdfs/12551IIED.pdf (20.07.11).

Cotula, L., Vermeulen, S., Leonard, R., Keeley, J., 2009. Land Grab or Developmental Opportunity? Agricultural Investment and International Land Deals in Africa. FAO, IIED, IFAD, http://www.ifad.org/pub/land/land_grab.pdf (12.07.10).

Dallu, A.I.M., 2003. Tropical secondary forest management in Africa: reality and perspectives. In: Tanzania Country Paper. For the FAO/EC LNV/GTZ Workshop on Tropical Secondary Forest Management in Africa: Reality and Perspectives, In Collaboration with ICRAF and CIFOR. Nairobi, Kenya, 9–13 December 2002, http://www.fao.org/docrep/006/j0628e/J0628E64.htm (23.05.13).

Deininger, K., 2011. Forum on global land grabbing: challenges posed by the new wave of farmland investment. J. Peasant Stud. 38 (2), 217–247.

Delgado, C., Minot, N., Tiongco, M., 2004. Evidence and implications of non-tradability of food staples in Tanzania 1983–1998, MTID Discussion Paper No. 72. International Food Policy Research Institute, Markets, Trends and Institutions Division, Washington.

Ellison, W., 1953. Marginal Land in Britain. G. Bles, London.

Exner, A., 2011. Teilbericht 4a: Ökologische und soziale Folgen der Biomassenproduktion für Energetische Zwecke. Die Situation in (Potenziellen) Exportländern mit Fokus auf den globalen Süden und dem Fallbeispiel Tanzania. EB&P Umweltbüro GmbH, Klagenfurt, http://www.umweltbuero-klagenfurt.at/sos/wp-content/uploads/Teilbericht_4a_Biomasse_Exner_Schlussversion.pdf (24.05.13).

Exner, A., 2013. The new land grab at the frontiers of the fossil energy regime. In: Exner, A., Fleissner, P., Kranzl, L., Zittel, W. (Eds.), Land and Resource Scarcity. Capitalism, Struggle and Well-being in a World without Fossil Fuels. Routledge, London/New York, pp. 119–162.

Forestry and Beekeeping Division, 1999. The Status of Non-Timber Forest Products in Tanzania. EC-FAO PARTNERSHIP PROGRAMME (1998–2000). Tropical forestry Budget line B7-6201/97-15/VIII/FOR PROJECT GCP/INT/679/EC, ftp://ftp.fao.org/docrep/fao/003/X6700E/X6700E00.pdf (21.06.13).

Fritz, T., 2010. Peak Soil. Die globale Jagd nach Land. FDCL Verlag, Berlin.

Fritz, S., Linda, S., van der Velde, M., Nalepa, R.A., Perger, C., Schill, C., McCallum, I., Schepaschenko, D., Kraxner, F., Cai, X., Zhang, X., Ortner, S., Hazarika, R., Cipriani, A., Di Bella, C., Rabia, A.H., Garcia, A., Vakolyuk, M., Singha, K., Beget, M.E., Erasmi, S., Albrecht, F., Shaw, B., Obersteiner, M., 2013. Downgrading recent estimates of land available for biofuel production. Environ. Sci. Technol. 47, 1688–1694.

Fritz, S., McCallum, I., Schill, C., Perger, P., See, L., Schepaschenko, D., van der Velde, M., Kraxner, F., Obersteiner, M., 2012. Geo-wiki: an online platform for improving global land cover. Environ. Model. Softw. 31, 110–123.

Fritz, S., McCallum, I., Schill, C., Perger, C., Grillmayer, R., et al., 2009. Geo-wiki.org: the use of crowdsourcing to improve global land cover. Remote Sens. 1, 345–354.

Ge, J.G., Qi, J., Lofgren, B.M., Moore, N., Torbick, N., Olson, J.M., 2007. Impacts of land use/cover classification on regional climate simulations. J. Geophys. Res. 112 (D05107), 12.

Grogan, K., Birch-Thomsen, T., Lyimo, J., 2013. Transition of shifting cultivation and its impact on people's livelihoods in the Miombo Woodlands of Northern Zambia and South-Western Tanzania. Hum. Ecol. 41, 77–92.

GTZ, 2005. Liquid Biofuel for Transportation in Tanzania: Potential and Implications for Sustainable Agriculture and Energy in the 21st Century, Abrufbar unter: http://tatedo.org/cms/images/researchdocs/biofueltransport.pdf (27.04.11).

Hannerz, F., Lotsch, A., 2006. Assessment of Land Use and Cropland Inventories for Africa, CEEPA Discussion Paper No. 22. Centre for Environmental Economics and Policy in Africa, University of Pretoria, http://www.ceepa.co.za/docs/CDPNo22.pdf (14.07.13).

Haugen, H.M., 2010. Biofuel potential and FAO's estimates of available land: the case of Tanzania. J. Ecol. Nat. Environ. 2 (March (3)), 30–37.

Igoe, J., Croucher, B., 2007. Conservation, commerce, and communities: the story of community-based wildlife management areas in Tanzania's northern tourist circuit. Conserv. Soc. 5 (4), 534–561.

Kachika, T., 2010. Landgrabbing in Africa. A Review of the Impacts and the Possible Policy Responses, http://www.oxfam.org.uk/resources/learning/landrights/downloads/land_grabbing_in_africa_impacts_&_policy_responses.pdf (11.04.11).

Kjekshus, H., 1977. Ecology Control and Economic Development in East African History: The Case of Tanganyika 1850–1950. University of California Press, Berkeley, Los Angeles.

Kwan, M.-P., 2002. Feminist visualization: re-envisioning GIS as a method in feminist geographic research. Ann. Assoc. Am. Geogr. 92 (4), 645–661.

Luoga, E.J., Witkowski, E.T.F., Balkwill, K., 2000. Economics of charcoal production in miombo woodlands of eastern Tanzania: some hidden costs associated with commercialization of the resources. Ecol. Econ. 35, 243–257.

Maltsoglou, I., Khwaja, Y. (Eds.), 2010. Bioenergy and Food Security. The BEFS Analysis for Tanzania. BEFS – Bioenergy and Food Security Project. FAO, http://www.fao.org/docrep/012/i1544e/i1544e00.htm (12.07.10).

Matondi, P.B., Havnevik, K., Beyene, A. (Eds.), 2011. Biofuels, Land Grabbing and Food Security in Africa. Zed Books, London/New York.

Maclean, A., Songela, F., 2008. Scoping Exercise (Situation Analysis) on the Biofuel Industry within and outside Tanzania, http://www.wwf.se/source.php/1203701/WWF_Tanzania_Scoping_Report_Biofuels.pdf (27.07.11).

Maddox, G., Giblin, J.L., Kimambo, I.N., 1996. Custodians of the Land. Ecology & Culture in the History of Tanzania. Ohio University Press, London/Dar es Salaam/Nairobi/Athens.

Makwarimba, M., Ngowi, P., 2012. Making Land Investment Work in Tanzania: Scoping Assessment for Multi-stakeholder Dialouge Initiative, http://www.tnrf.org/LBI-report.pdf (03.06.13).

Malley, Z.J.U., Semoka, J.M.R., Kamasho, J.A., Kabungo, C.V., 2006. Participatory assessment of soil degradation in the uplands of southwestern Tanzania: implications for sustainable agriculture and rural livelihoods. Int. J. Sustain. Dev. World Ecol. 13 (3), 183–197, http://dx.doi.org/10.1080/13504500609469671.

Mangora, M.M., 2005. Ecological impact of tobacco farming in miombo woodlands of Urambo District, Tanzania. Afr. J. Ecol. 43, 385–391.

McGahey, D.J., 2008. Bioenergy and Pastoralism: Challenging the Wastelands Myth. SOS Sahel International UK (A drynet Science and Technology Expertise. drynet is a project funded by the European Union and supported by The Global Mechanism), http://www.globalbioenergy.org/uploads/media/0810_Drynet_-_Bioenergy_and_pastoralism.pdf (14.07.14).

Meertens, B., 2000. Agricultural performance in Tanzania under structural adjustment programs: is it really so positive? Agric. Hum. Values 17, 333–346.

Mwampamba, T.H., 2009. Forest Recovery and Carbon Sequestration Under Shifting Cultivation in the Eastern Arc Mountains, Tanzania: Landscape and Landuse Effects. University of California, Davis (Doctoral Thesis), http://gradworks.umi.com/33/96/3396907.html (27.05.13).

Mwampamba, T.H., Schwartz, M.W., 2011. The effects of cultivation history on forest recovery in fallows in the Eastern Arc Mountain, Tanzania. For. Ecol. Manag. 261 (6), 1042–1052.

Nalepa, A.R., Bauer, D.M., 2012. Marginal lands: the role of remote sensing in constructing landscapes for agrofuel development. J. Peasant Stud. 39 (2), 403–422.

Nduwamungu, J., Bloesch, U., Munishi, P.T.K., Hagedorn, F., Lulu, K., 2008. Recent land cover and use changes in Miombo Woodlands of Eastern Tanzania. Tanzan. J. For. Nat. Conserv. 78 (1), http://www.ajol.info/index.php/tjfnc/article/view/52023 (04.07.13).

Neumann, R.P., 1998. Imposing Wilderness. Struggles over Livelihood and Nature Preservation in Africa. University of California Press.

Ngoitiko, M., Sinandei, M., Meitaya, P., Nelson, F., 2010. Pastoral activists: negotiating power imbalances in the Tanzanian Serengeti. In: Nelson, F. (Ed.), Community rights, conservation and contested land. The politics of Natural Resource governance in Africa. Earthscan, London, pp. 269–289.

Olenasha W. (s.d.), Reforming Land Tenure In Tanzania: For Whose Benefit?, http://www.oicrf.org/document.asp?ID=8792 (23.05.14).

Oya, C., 2010. Agro-pessimism capitalism and agrarian change: trajectories and contradictions in Sub-Saharan Africa. In: Padayachee, V. (Ed.), The Political Economy of Africa. Routledge, London/New York, pp. 85–109.

Oxfam, 2008. Survival of the Fittest. Pastoralism and Climate Change in East Africa. Oxfam Briefing Paper., pp. 116.

Peterson, G.M., Galbraith, J.K., 1932. The concept of marginal land. J. Farm Econ. 14 (April (2)), 295–310.

Raikes, P., 1986. Eating the carrot and wielding the stick: the agricultural sector in Tanzania. In: Boesen, J., Havnevik, K.J., Koponen, J., Odgaard, R. (Eds.), Tanzania – Crisis and Struggle for Survival. Scandinavian Institute of African Studies, Uppsala, pp. 105–142.

Ramadhani, A., 2007. The Socio-Economic and Environmental Impacts of a Biofuel Industry in Tanzania, http://www.envirocaretz.org/uploaded_Polices/Biofuel%20report%20by%20abdallah.pdf (27.07.11).

Renewable Fuels Agency, 2008. The Gallagher Review of the indirect effects of biofuel production, http://www.bioenergy.org.nz/documents/liquidbiofuels/Report_of_the_Gallagher_review.pdf (08.08.11).

Robbins, P., 2003. Beyond ground truth: GIS and the environmental knowledge of herders, professional foresters, and other traditional communities. Hum. Ecol. 31 (June (2)), 233–253.

Romijn, H., Caniëls, M., 2010. The Jatropha biofuels sector in Tanzania 2005–9: evolution towards sustainability? Res. Policy, http://dx.doi.org/10.1016/j.respol.2011.01.005.

Sarwatt, S., Mollel, E., 2000. Country Pasture/Forage Resource Profiles. United Republic of Tanzania. FAO (Edited by J. M. Suttie, in 2000 and livestock data modified by S.G. Reynolds in August 2006), http://www.fao.org/ag/AGP/agpc/doc/Counprof/tanzania/tanz.htm (23.06.13).

Scott, J., 1998. Seeing Like a State. How Certain Schemes to Improve the Human Condition Have Failed. Yale University Press, New Haven/London.

Scoones, I. (Ed.), 1994. Living with Uncertainty: New Directions in Pastoral Development in Africa. Intermediate Technology Publications, London.

Siebert, S., Portmann, F.T., Döll, P., 2010. Global patterns of cropland use intensity. Remote Sens. 2, 1625–1643.

Sulle, E., Nelson, F., 2009. Biofuels, land access and rural livelihoods in Tanzania. IIED, http://www.iied.org/pubs/pdfs/12560IIED.pdf (14.07.14).

The Gaya Foundation, Biofuelwatch, the African Biodiversity Network, Salva La Selva, Watch Indonesia, EcoNexus, 2008. Agrofuels and the Myth of the Marginal Lands, http://www.econexus.info/sites/econexus/files/Agrofuels_&_Marginal-Land-Myth_0.pdf (14.07.14).

URT, 1999a. The village land act. An act to provide for the management and administration of land in villages, and for related matters. Act No. 5 of 1999.

URT, 1999b. The land act. An act to provide for the basic law in relation to land other than the village land, the management of land, settlement of disputes and related matters. In: Act No. 4 of 1999.

URT, 2006a. National Sample Census of Agriculture 2002/2003. Volume I: Technical and Operation report.

URT, 2006b. National Sample Census of Agriculture 2002/2003. Small Holder Agriculture. Volume II: Crop Sector – National Report.

URT, 2006c. National Sample Census of Agriculture 2002/2003. Large Scale Farms. Volume IV.

URT, 2012a. National Sample Census of Agriculture 2007/2008. Small Holder Agriculture. Volume II: Crop-Sector-National Report.

URT, 2012b. National Sample Census of Agriculture 2007/2008. Large Scale Farms. Volume IV.

URT, 2012c. National Sample Census of Agriculture. Small Holder Agriculture. Volume III: Livestock Sector – National Report.

URT, 2013. 2012 Population and Housing Census: Population Distribution by Administrative Areas.

Vetter, S., 2004. Rangelands at equilibrium and non-equilibrium: recent developments in the debate. J. Arid Environ. 62, 321–341.

Widengård, M., 2011. Biofuel governance: a matter of discursive and actor intermesh. In: Matondi, P.B., Havnevik, K., Beyene, A. (Eds.), Biofuels. Land Grabbing and Food Security in Africa. , pp. 44–59.

Wood, S., Sebastian, K., Scherr, S.J., 2000. Pilot Analysis of Global Ecosystems. Agroecosystems. World Resources Institute and International Food Policy Research Institute, Washington, DC.

World Bank, 2010. Rising Global Interest in Farmland. Can it Yield Sustainable and Equitable Benefits?, Washington, DC.

World Bank, 2008. Putting Tanzania's Hidden Economy to Work: Reform. Management and Protection of its Natural Resource Sector, Washington, DC.

Yanda, P.Z., Shishira, E.K., 1999. Land cover changes and their influencing factors in Tanzania. In: Ravichandran, V. (Ed.), Regional Land Cover Changes, Sustainable Agriculture and Their Interactions with Global Change. Universities Press, Hyderabad, pp. 49–59.