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Locating the Margin? Agriculture and Livelihoods Along the Rural-Urban Continuum of African mid-Sized Towns

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Introduction

Subsistence and market agriculture typically play a significant role in the local livelihoods of people in rural sub-Saharan Africa. Increasing evidence also points to its importance for income generation and food security of many urban and periurban households (FAO 2009). This aspect becomes more important as the urban population in Africa is expected to double by 2025 (UNITED NATIONS 2010). Today, Africa is the world's least urbanised, but fastest urbanising continent. Medium-sized cities are highly dynamic and often characterised by manifold transformation processes. One of them is the conversion of areas traditionally shaped by agricultural activities into zones fulfilling urban functions. Yet there is limited conception or understanding of how the relative contribution of agriculture to local livelihoods changes along dynamic urbanising gradients. Marked spatial and temporal changes in human population density, governance systems, land and resource tenure arrangements and other opportunities potentially change the relative contribution and significance of agriculture to local livelihoods. This paper presents an innovative set of methods to analyse and visualise changes along the rural-urban continuum. The findings build on a case study undertaken in Moshi, a municipality of about 180.000 inhabitants (MOSHI MUNICIPAL COUNCIL 2010) located on the foothills of Mt. Kilimanjaro, Tanzania. This study is embedded in a research project comparing six medium-sized cities in five African countries.

Material and Methods

A twofold approach combining social science methods and land use analysis was applied. On the one hand a comprehensive data set on the importance of agriculture for the livelihoods of Moshi´s inhabitants was generated. On the other hand spatial changes of land use patterns along the rural-urban continuum were mapped. A transect approach formed the basis for data collection, processing and analysis. Four transects originating at the city's central market were laid out. In contrast to the common approaches where transects are understood as lines (LUCK AND SMALLBONE 2010, ALBERTI 2008), polygonal transects were used in this study. Each of these polygons was 100 metres wide and up to 8.5 kilometres long.
Within each transect, a *Geographic Information System (GIS)* was applied to randomly sample 404 households that were interviewed with a standardised questionnaire to assess the importance of agricultural activities for the individual households. Secondly, the land use patterns within the transects were mapped using high-resolution satellite imagery and *in situ* methods. Additionally,

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semi-structured interviews with key informants (e.g. municipality and ward officials) were conducted.
The transects were divided into up to 84 sectors of equal size forming the geographic basis for data analysis (see Figure 1). Each sector was assigned an individual number which corresponds to the location of the sector, starting with *sector 1* in the city centre.

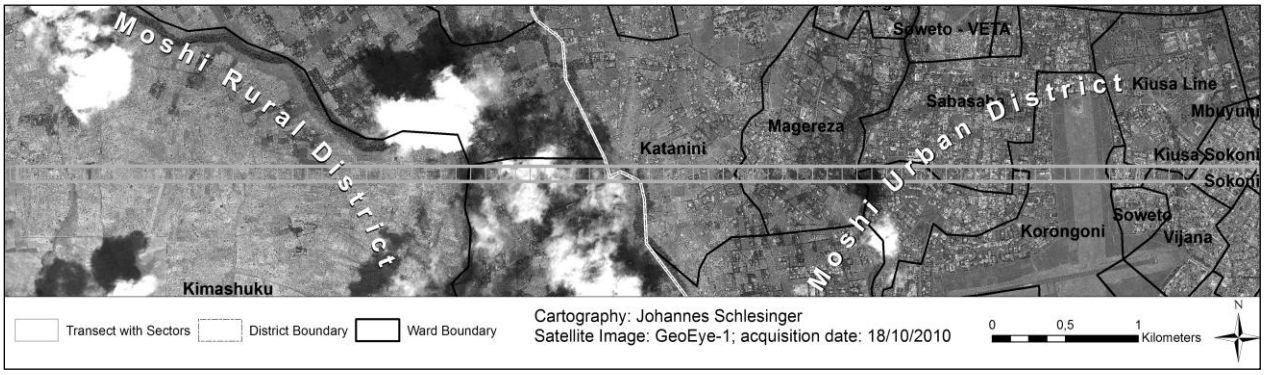

Figure 1: Example of transect polygon with sectors

For each of these sectors several index values (e.g. *Agricultural Land Use, Households' Agricultural Activity, Agricultural Activity Index*) were calculated based on land use data and household data. The following formula was applied:

$$i_x = \frac{v_{x-1} + v_x + v_{x+1}}{3 * v_{max}}$$

i_x	index score for sector x
v_x	measured value for sector x
v_{x-1}	measured value for sector x-1
v_{x+1}	measured value for sector x+1
v_{max}	maximum value measured within transects

Example 1: Agricultural Land Use Index (ALUI)
All areas utilized for agricultural production within the transects have been mapped. A GeoEye-1 satellite image with a resolution of 0.5 metres was used as a base map. The collected analogue data was digitised as polygons in ArcGIS 10. Afterwards it was converted into raster data in order to perform Zonal Statistics based on the sectors. For each sector an individual value was calculated expressing the percentage of the sector's area used for agricultural purposes.

Example 2: Households' Agricultural Activity on field/on homestead plot (AA(F) and AA(H))
During the household survey, information on the households' involvement in agricultural activities was collected. The dataset includes information on the households' activities on fields and on their homestead plots, respectively. The information was geocoded for further analysis in ArcGIS. After rasterisation, Zonal Statistics was performed and an index value was calculated.

Example 3: Agricultural Activity Index (AAI)
Based on the abovementioned indices, a comprehensive *Agricultural Activity Index (AAI)* could be developed. This index combines land use data generated through *in situ* mapping and information on the household's activity from the household survey. The AAI was calculated based on this formula:

$$AAI_x = \frac{ALUI_x + AA(F)_x + AA(H)_x}{n_x}$$

AAI_x	*Agricultural Activity Index* score for sector x
$ALUI_x$	*Agricultural Land Use Index* score for sector x
$AA(F)_x$	*Households' Agricultural Activity on Field Index* score for sector x
$AA(H)_x$	*Households' Agricultural Activity on Homestead Plot Index* score for sector x
n_x	number of available index scores for sector x

Results and Discussion

Rural-urban continuum rather than rural-urban dichotomy

The visualisation of the index scores of all sectors along an exemplary transect (Figure 2) show the gradual changes along the rural-urban continuum. Based on the household survey data, it could be shown that the importance of agricultural production gradually grows with increasing distance from the transect origin (see top part of Figure 2). This applies to agricultural activities on the homestead plot as well as to the households' agricultural production on fields somewhere else. The analysis of land use data generated through *in situ* mapping shows gradual changes for building density (decreasing), construction activity and the overall *Agricultural Activity Index* (increasing) (see bottom part of Figure 2). All the mentioned indices show statistically significant correlations to distance from transect origin. The only exception is the *Agricultural Diversity Index* which is steadily increasing to its maximum in the periurban before decreasing again (Table 1).

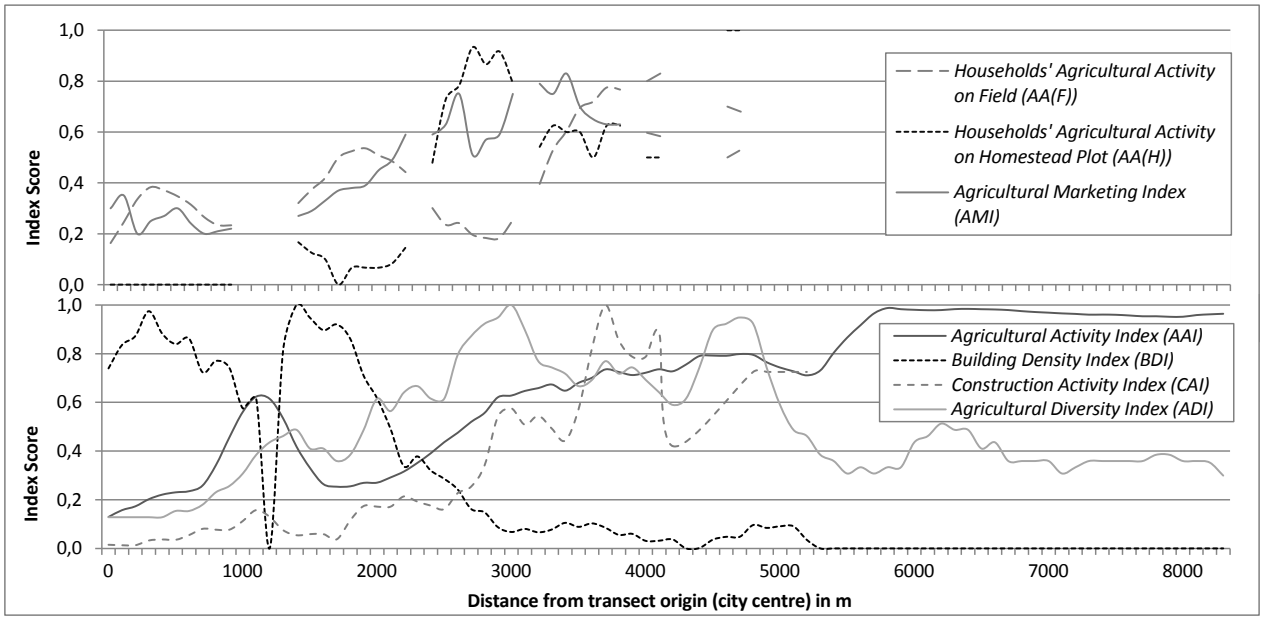

Figure 2: Visualisation of selected index scores based on household survey (top) and *in situ* mapping (bottom)

Table 1: Correlation coefficients (Pearson) of selected indices and distance from transect origin

	Index	Correlation coefficient
Survey based	*Households' Agricultural Activity on Field (AA(F))*	.604**
	Households' Agricultural Activity on Homestead Plot (AA(H))	.849**
	Agricultural Marketing Index (AMI)	.846**
Mapping based	*Agricultural Activity Index (AAI)*	.928**
	Building Density Index (BDI)	-.890**
	Construction Activity Index (CAI)	.893**
	Agricultural Diversity Index (ADI)	-.001

** Statistically significant at the 0.01 level

Periurban areas are highly dynamic

The results show that the periurban areas are highly dynamic. These are the areas where most aspects of transformation in relation to urbanisation can be found (IAQUINTA AND DRESCHER 2000). These areas are very heterogeneous in terms of land use, household figures and social structures such as land tenure systems. This human-made heterogeneity is reflected in a high diversity of agricultural production systems. The periurban is characterized by a high *Construction Activity Index (CAI)* as this is the area where construction sites are still available.

The relative proximity to the city centre makes these areas attractive for investments. On the other hand, these periurban areas are still important for agricultural purposes as the respective indices show. Many livelihoods are based on agricultural production, be it for subsistence purposes or for the generation of income through the marketing of agricultural products (FOEKEN ET AL. 2004). Accordingly, these areas are hot spots of transformation and they bear a high potential for conflicts over the use of space and resources.

Generally high involvement of urban households in agricultural activities
The results indicate that the contribution of agriculture to local livelihoods is dynamic in space and time. Whilst there was the expected decrease in the importance of agriculture with increasing urbanisation, the results regarding prevalence were less predictable. At more nuanced levels there was high variability between towns, between locations along the rural-urban continuum, and even between households at specific points along the continuum. These results show that there are no distinct margins in space or time for agricultural activities in mid-sized sub-Saharan African towns. Furthermore, the Moshi household survey has shown that the common assumption that urban dwellers are usually not involved in "rural activities such as agriculture" (MOSHI MUNICIPAL COUNCIL 2010) is wrong. Within Moshi's densely populated city centre more than one third of the interviewed households are actively involved in agricultural activities. This does not necessarily implicate that these households have farms within the administrative boundaries of the municipality. However, they are urban farmers that are often overlooked by relevant agricultural support programmes. With increasing distance from the city centre, agricultural production and its role for the livelihoods becomes even more important. Yet, the existence of agricultural production within the administrative area of the municipality is often overlooked or even neglected. Accordingly, development plans and policies do not reflect the situation of the affected households and are therefore often not sustainable.

Conclusions and Outlook

The transect approach applied in this study proved appropriate and is a convenient tool for data collection, processing, analysis and visualisation. Contrary to previous assumptions, it could be shown that the rural-urban continuum is more suitable for the understanding of urbanisation processes than the predominant artificial rural-urban divide. The dichotomous thinking in rural-urban categories has to be overcome in order to formulate appropriate programmes and policies. Town planning and land use zonation have to take this continuous character of urbanisation into account. Especially the periurban transformation process has to be addressed through appropriate town planning measures. Until to date, this area is often overlooked as it cannot be clearly categorised as either *urban* or *rural*. In many medium-sized cities in Africa, these transformation zones are marginalised. The existence of *institutional deserts* is a consequence.
There is a need for the intensification of research efforts when it comes to spatial and social transformation processes linked to urbanisation. This especially applies to the chronically under-researched medium-sized cities where there are still options for steering the developments into the right direction.

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