Modelling Urban Deprivation in West Africa

Felicia Akinyemi[1] and Birgit Elias[2]

[1]Centre for GIS and Remote Sensing
National University of Rwanda
felicia.akinyemi@gmail.com

[2]Institute of Cartography and Geoinformatics
Leibniz Universität Hannover, Germany.
birgit.elias@ikg.uni-hannover.de

1   INTRODUCTION

Deprivation refers to peoples' unmet needs (Noble et al. 2006) and focuses on what people can do or can be in their specific socio-cultural environment (Mcintyre et al. 2002).   Examples of studies examining urban deprivation are North America (McDonald 2004, Langlois and Kitchen 2001); UK (Macintyre et al. 2008); Hong Kong (Forrest et al. 2004); West Africa (Oduro and Aryee 2003, Grimm and Günther 2007, Mitlin 2005, Abiodun and Boateng 1987).

This study aims at:

- Generating rules for automatically classifying deprived households
- Characterizing key urban deprivation types

2   URBANISATION IN WEST AFRICA

We compared Africa's urbanization rate to that of West Africa (see Figures 1 and 2). The Figures show percentage urbanisation and urbanisation change rate respectively. West Africa's urbanization rate is higher than African's average.
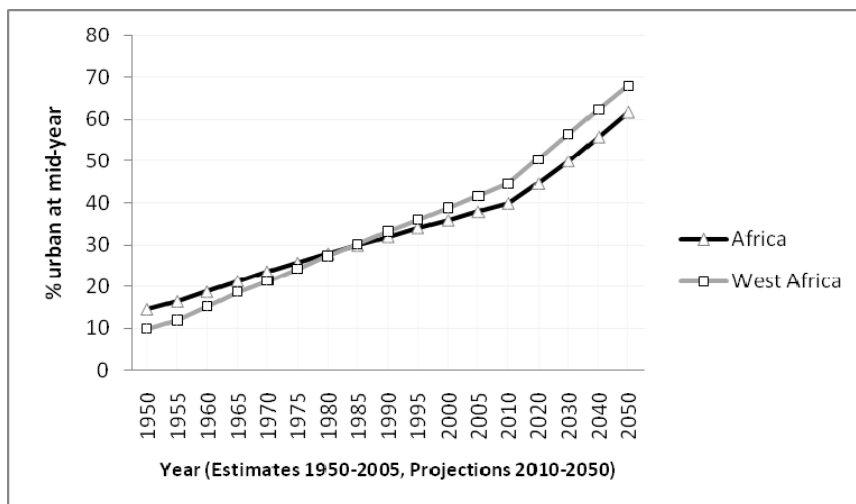

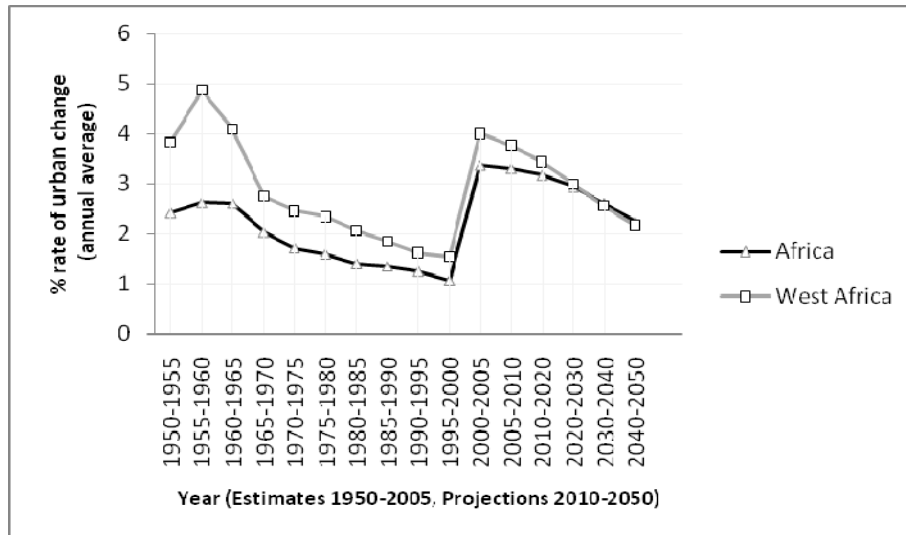***Figure 1:*** Percentage urbanisation.

Figure 2: Urban rate of change.

With rapid urbanisation, governments cannot cope with providing infrastructure and basic services.

3 STUDY AREA

Ibadan's population in 2005 is 2509000 (http://nigeriannews.com/census/census2006.htm). Figure 3 shows Ibadan's location and the sample residential density neighbourhoods.

3.1 Data

Based on Abiodun and Boateng (1987), twenty variables were employed (see Table 1) with household data aggregated at neighbourhood level.

4 METHODOLOGY

This paper aims at generating rules for automatically detecting deprived urban households. For household level analysis, the J48 supervised classifier was used as a data mining technique to extract decision rules with an "if" part of the rule containing the condition and a "then" part regarding the rule execution (see Miller and Hans 2001). A supervised classifier works well when a priori knowledge exists to form the basis for households to be classified. Secondly, key urban deprivation dimensions were characterized using Principal component analysis (PCA) and correlation at neighbourhood level.
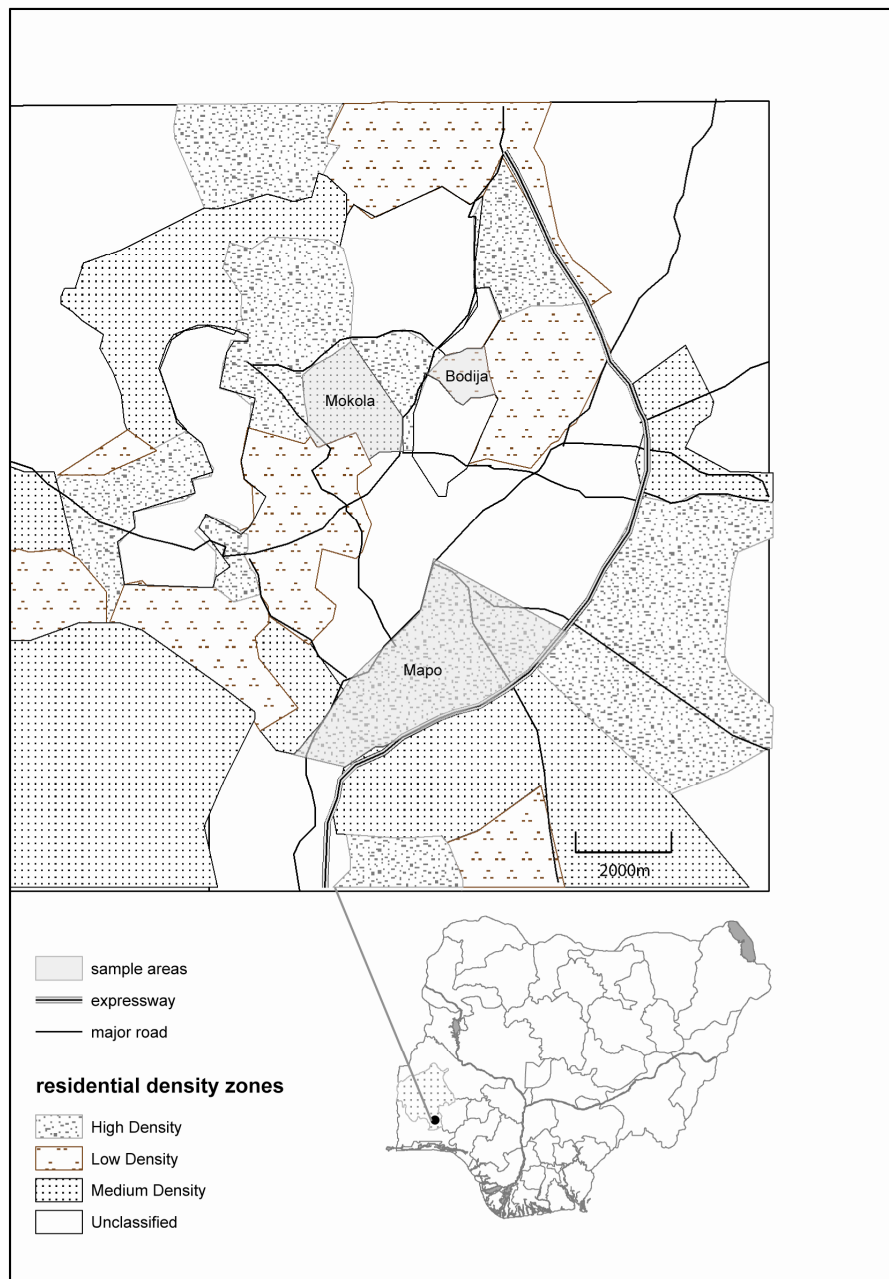
Figure 3: Residential density zones in Ibadan (Insert map: Ibadan in Nigeria).

Dimension	Indicators	Mean	Standard deviation	Minimum	Maximum	Range
INCOME	below-median-per-capita-income	25.67	22.01	4	48	44
EMPLOYMENT_STATUS	low-income-workers	6.67	6.43	2	14	12
	middle-income-personnel	3	1	2	4	2
	top-personnel	7.67	10.70	1	20	19
EDUCATION	no-education	11.33	10.02	1	21	20
	up-to-primary-6	14.67	14.05	0	28	28
	>primary-6-but<university	16	12	4	28	24
	university	16.67	21.08	4	41	37
	advanced-university	2.33	4.04	0	7	7
HOUSING	mud-houses	33	35.38	1	71	70
	cement-house	32.33	23.18	11	57	48
	house-exterior	52.33	11.59	40	63	23
	occupancy-ratio >2	33.67	29.60	8	66	58
	household-with-single-room	21.67	27.79	0	53	53
WATER	Neighbourhood-tap	12	12.49	26	2	24
SANITATION_FACILITIES	water-closet-at-home	29.33	21.127	5	43	38
	bath-at-home	27.33	11.55	14	34	20
	refuse-disposal-system	47.67	14.19	35	63	28
ASSET	electricity-generator	8	9.64	1	19	18
	Car	17.33	13.80	7	33	26

Table 1: Descriptive statistics.

5   RESULTS AND DISCUSSION

Figure 4 shows the decision tree with the first part, 'per-capita-income-naira' (naira is Nigerian currency) representing the parent node. Three lines extending from the node link the rules. If the expression is true, an instance is classified according to any of the three rules. If followed by a class designation, as in the third level, either of these class designations becomes the classification rule.
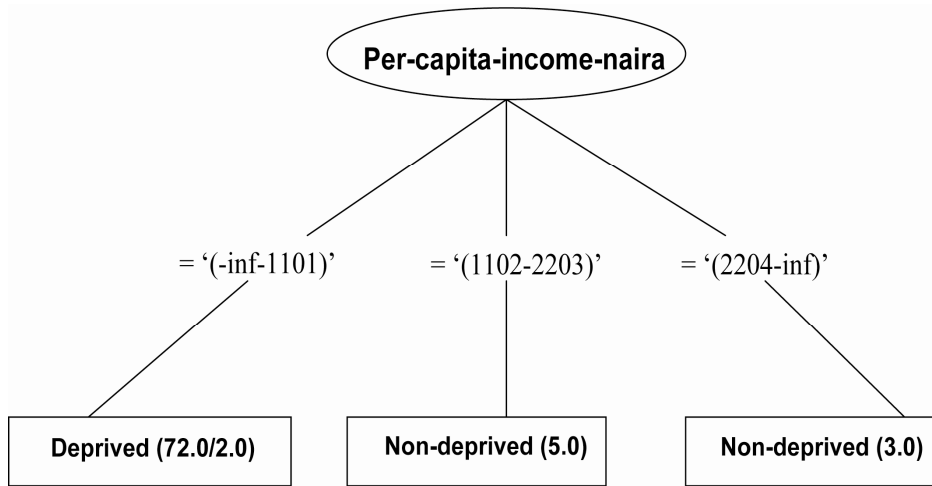
Figure 4: A decision tree for classifying households.

The left-hand rule is 'If per-capita-income is less than or equal to 1,101 Naira, then classify household as deprived' (see Eq. 1).

$$PCI \leq 1101 Naira : deprived \rightarrow (72.0 / 2.0) \qquad (1)$$

This node correctly classified 72 households with two instances incorrect.

From a 2-component-PCA (88% variance) variables with positive loadings on Factor 1 (signifying deprivations) are ">primary-6-but<university-education", "no-education" and "<median-per-capita-income)". Relating factor 1 to neighbourhoods, the high-density loads positively high on Factor 1, followed by the medium-density, whereas the low-density loaded negatively high on Factor 1. Occurrence of multiple deprivations is highest in high-density than other neighbourhoods.

Indicators of low-education ("no-education", "up-to-primary-6" and ">primary-6-but<university"), poor-housing ("houses-built-with-mud", "occupancy-ratio>2", "households-with-a-single-room") and "refuse-disposal-system" reveal high positive correlation to "median-per-capita-income. Some variables with high negative correlation are high-education indicators ("university" and "advanced-university-education"), "car-ownership", standard-sanitary-facilities ("water-closet-and-bath") and good-quality-housing ("decent-house-exterior", "houses-built-with-cement").

Not implying causality, households experiencing income deprivation also experience knowledge deprivation (having no-education or low-education), likely low-income-workers and have limited living space.

6   CONCLUSION

This work describes the characterisation of deprivation as observable in Ibadan. Analysis was carried out at two levels namely: neighbourhood and household. The neighbourhood level analysis

was aimed at characterising deprivation patterns while the household level analysis identified important variables. The possibility of generating meaningful classification rules for classifying households into deprived or non-deprived classes based on income was demonstrated. This is a major contribution of this study. With better refinement, more articulate classification rules for depicting various deprivation types can be derived.

BIBLIOGRAPHY

Abiodun J.O. and Boateng S.Y. 1987. The Spatial Pattern of Residential Inequalities in Ibadan Metropolitan Area. *Ife Social Sciences Review*, 10/1,2:7-25.

Forrest R., La Grange A. and Yip,N. 2004. Hong Kong as a Global City? Social Distance and Spatial Differentiation. *Urban Studies*, 41(1):207-227.

Grimm,M. and Günther,I. 2007. Growth and Poverty in Burkina Faso:A Reassessment of the Paradox. *African Economies*, 16(1):70-101.

Langlois,A. and Kitchen,P. 2001. Identifying and Measuring Dimensions of Urban Deprivation in Montreal:An Analysis of the 1996 Census Data. *Urban Studies*, 38(1):119-139.

Macintyre Sally, Macdonald Laura and Anne Ellaway 2008. Do poorer people have poorer access to local resources and facilities? The distribution of local resources by area deprivation in Glasgow, Scotland. *Social Science & Medicine*, 67(6):900-914.

McDonald,J.F. 2004. The Deconcentration of Poverty in Chicago:1990-2000. *Urban Studies*, 41(11):2119-2137.

Mcintyre D., Muirhead,D., and Gilson,L. 2002 Geographic Patterns of Deprivation in South Africa:Informing Health Equity Analyses and Public Resource Allocation Strategies, *Health Policy and Planning*, 17(Suppl.1):30–39.

Miller, H.J. and Hans,J. eds. (2001) Geographic Data Mining and Knowledge Discovery:An Overview. Geographic Data Mining Knowledge Discovery, Taylor and Francis, London, 1-32.

Mitlin D. 2005. Understanding Chronic Poverty in Urban Areas. *International Planning Studies*, 10(1):3-19

Noble,M. et al. 2006. *The Provincial Indices of Multiple Deprivation for South Africa 2001*. University of Oxford.

Oduro A.D. and I. Aryee 2003. Investigating Chronic Poverty in West Africa. No 28, Chronic Poverty Research Centre, ISBN Number: 1-904049-27-3.

Witten I.H. and F. Eibe 1999. *Data Mining:Practical Machine Learning Tools and Techniques with Java Implementations*. Morgan Kaufman, San Francisco.