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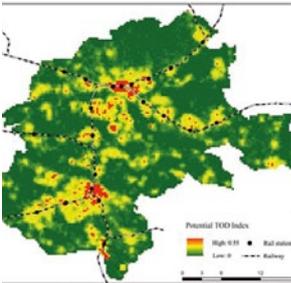
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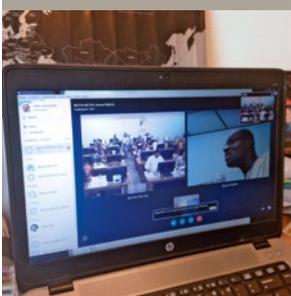
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As many cities in the global South are faced with both the rapid growth of existing slums and the emergence of new slums, which sometimes house more than 50% of the urban inhabitants, the development of efficient and effective methods for slum mapping continues to be an important issue for the PGM department.



INTRODUCTION



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To come straight to the point, the core theme of ITC News 2015-2 is urbanization. As this is one of the leading global trends of the 21st century and “the urban population of the world is expected to increase by more than two thirds by 2050” (page 3 The Future is Urban), it’s safe to say that a good many of our readers will find much of interest among the following pages. This is especially so since urbanization encompasses a wide range of issues – issues that not only concern city dwellers themselves but also have far-reaching implications for the national good.

Exploring urban growth patterns (see article on page 4) indicates that rapid urbanization can go hand in hand with increasing motorization, and economic growth is often associated with rising levels of industrialization. Transit-oriented development (page 22) and the establishment of a user-friendly bicycle network (page 15) are just two options that have been claiming the attention of ITC researchers in the field of urban transportation. There’s little doubt that accessibility and mobility – for example, from home to work, from home to school and vice versa – play a key role in the lives of citizens, and an efficient transport infrastructure contributes substantially to their quality of life (page 18).

Unfortunately, the economic benefits springing from urbanization are rarely distributed evenly, but much work is also currently in progress to advance the interests of disadvantaged communities and slum dwellers, witness the new initiatives in settlement upgrading (page 11).

Whatever the season, work (research), work (education) and yet more work (capacity development) is always much in evidence at ITC. But if in your part of the world, as currently here in Enschede, it’s the time when many families take their annual break, maybe you could do worse than visit Flickr (page 29) to garner ideas ... and perhaps add some input of your own.

Welcome to ITC News 2015-2!

Virtually yours,
Jorien Terlouw
Editor

The Future is Urban

Martin van Maarseveen

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Our world today is predominantly urban. A fresh future is taking shape, with urban areas around the world becoming not just the dominant form of habitat for humankind, but also the engine rooms of human development as a whole. A critical mass of people, ideas, infrastructure and resources acts as a magnet for development, attracting migrants, private firms, investors and developers. All of this enhances the prospects for more employment opportunities, wealth creation, innovation and knowledge, which are all major factors of prosperity. Yet the prosperity generated by cities has not been equitably shared, and a sizeable proportion of the urban population remains without access to the benefits that cities produce. Cities must give more attention to these rising inequalities and the worrying trend of environmental degradation.

The urban population of the world is expected to increase by more than two thirds by 2050, with nearly 90 percent of the increase taking place in the urban areas of Africa and Asia. A defining feature of cities in the developing world is an outward expansion far beyond formal administrative boundaries, largely propelled by the use of the automobile and land speculation. Cities are expanding in a discontinuous, scattered and low-density form that is not sustainable. Considering the “natural” or “spontaneous” growth of large urban configurations, cities and regions in the developing world must introduce regional planning strategies to mitigate any adverse side-effects and harness the opportunities and potentials that are concentrated in those large agglomerations.

The Rio +20 Conference outcome, “The future we want”, recognized that cities can lead the way towards economically, socially and environmentally sustainable societies, but that a holistic approach to urban planning and management is needed to improve living standards of urban and rural dwellers alike. Sustainable urbanization requires cities to generate better income and employment opportunities; expand the necessary infrastructure for water and sanitation, energy, transportation, information and communications; ensure equal access to services; reduce the number of people living in slums; and preserve the natural assets within the city and surrounding areas.

This special issue on urbanization provides a snapshot of the latest contributions in research, education and capacity development of the Department of Urban and Regional Planning and Geo-Information Management (PGM) on this topic. It demonstrates how the department contributes to the delivery of accurate, consistent and timely data and information on global and local trends in urbanization and city growth that are critical for assessing current and future needs and for setting policy priorities to promote inclusive and equitable urban and rural development. ■



Prof dr ir Martin van Maarseveen

More information about the PGM department can be found on our website: <http://www.itc.nl/PGM>.

Exploring Future Urban Growth Patterns

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In the developing world, the pace of the urban population growth rate has slowed down from just under 3 percent in the year 2000 to 2.4 percent in 2010. However, it is still three and a half times higher than the annual average population growth rate in developed countries. Moreover, a study on 120 cities shows that urban land cover has, on average, grown more than twice as much as the urban population. These observations emphasize the need for a better understanding of the driving forces of urban growth, and their complex interactions. This information is considered vital for urban planners and policy makers to mitigate the negative consequences of urban growth and to plan for appropriate policy interventions.

Remote sensing and GIS have been applied for mapping and monitoring urban growth in a vast number of studies. More recently, these methods, as well as the data these methods can generate, have appeared to be very useful in constructing urban indicators and deriving and testing relationships between these indicators and urban growth. This enables the design, calibration and validation of dynamic urban land use models, which can be used to forecast future urban land use and expansion and to support decision making for planning purposes.

The transport system is one of the main drivers of urban growth, through the accessibility and economic opportunities it provides to surrounding land and activities. Therefore, it is crucial to study the mutual relationship between urban dynamics and transport. Land use models, especially cellular automata (CA) models, offer a good platform to study urban dynamics. In many of these models, accessibility is widely acknowledged as a key determinant of land use changes. However, accessibility is often treated in a rather static and simplified fashion and defined as the proximity to major infrastructure elements or important locations.

Within the PGM department, two PhD studies have been conducted with a more advanced notion of accessibility within a CA land use model. In the first case study, for the fast-growing and highly motorized metropolitan area of Jeddah in Saudi Arabia, Mohammed Aljoufie used performance indicators of the transport system, in particular traffic volumes and recurrent congestion levels in the road network, to calculate accessibility. He coupled dynamically the CA model with a travel demand model (Figure 1).

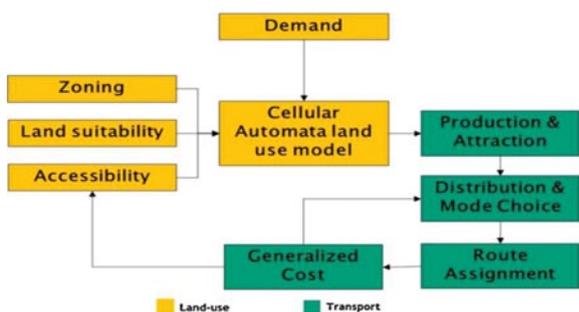


Figure 1 Structure of the coupled CA land use model and travel demand model

Using data extracted from a time series of satellite images (Figure 2), the model has been calibrated and validated successfully. The results of the study reveal a strong mutual relationship between land use and transport. The simulations demonstrate that under the current trend scenario Jeddah will experience enormous urban growth and transport challenges in 2030.

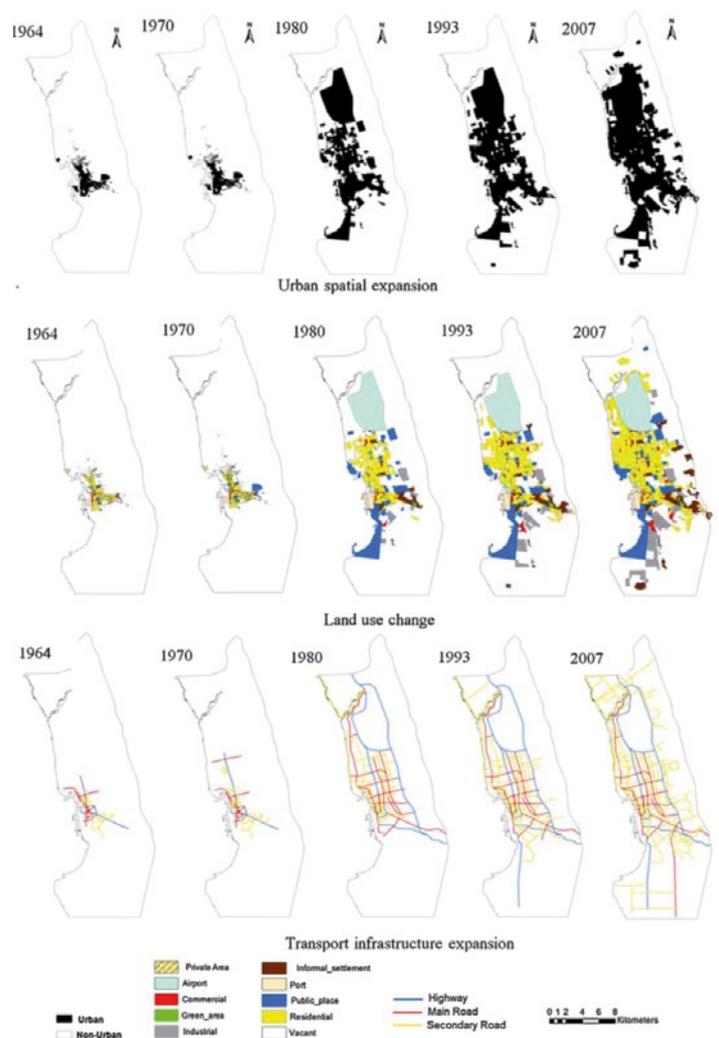


Figure 2 Reconstruction of historical spatial-temporal developments of Jeddah

Stand-alone land use planning or transport planning policies will have only moderate impact; integrated land use and transport policies are clearly needed to face the future challenges.

Ha Noi City, capital city and one of the two largest and fastest-urbanizing cities in Vietnam, is the location of the PhD study of Quang Ngoc Nguyen. Since the transition of the economy from a highly centralized planning style to liberal market mechanisms that encourage initiatives of the private sector, Ha Noi has been witnessing rapid urbanization and motorization, further stimulated by accelerated economic growth in association with high levels of industrialization. In this study, a CA model was constructed based on different accessibility notions: for example, the more advanced notion of potential accessibility to jobs (Figure 3). The prevailing masterplan (Figure 4), in which urban development is

stimulated in five satellite towns connected to the main city by major road infrastructure, acts as the baseline in a scenario analysis for the year 2030. A major result of this study is that changing the Ha Noi region from a monocentric to a polycentric structure turns out to be quite a planning challenge. Urban development in satellite cities is hard to achieve because of strong competition from the dominant job market in the main city.

The two studies show that the combination of CA land use models, GIS and satellite data creates challenging opportunities to analyse spatial and temporal dimensions of urban growth patterns at a more aggregate scale, and to evaluate and compare the impacts of different urban planning policies on land use and transport developments. ■

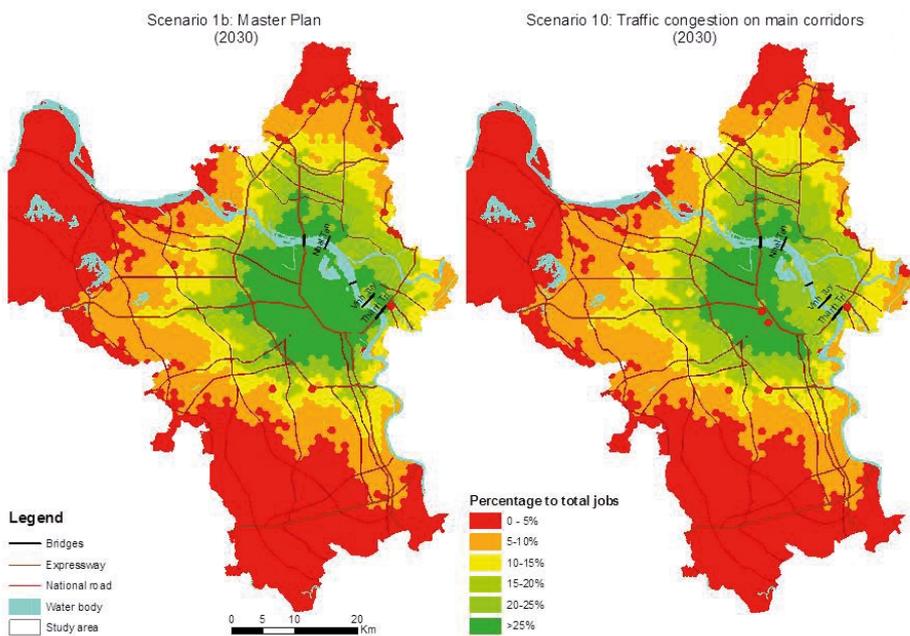


Figure 3 Comparison of accessibility to jobs in two scenarios for Ha Noi City in 2030

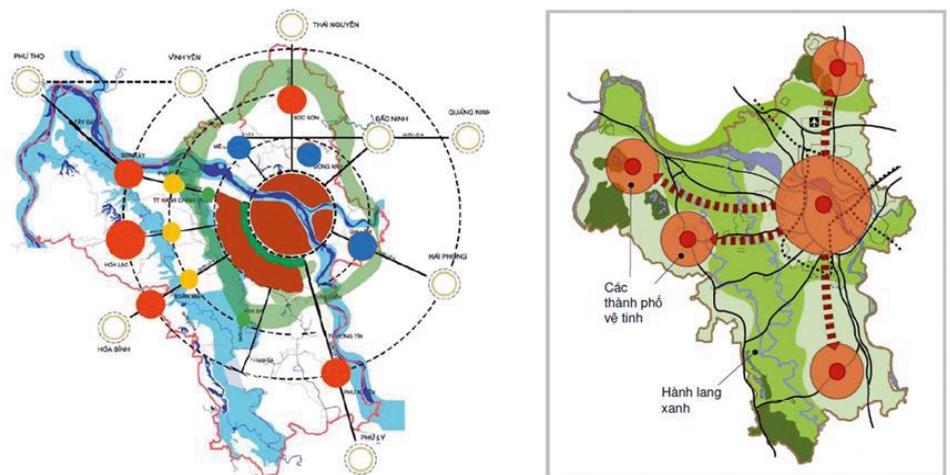


Figure 4 Ha Noi Masterplan (source: PPJ, 2010)

Urban Dynamics on a Micro-Scale

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An increasing amount of PGM’s research activity addresses the modelling of urban dynamics at a micro-scale. We consider such models to be a very useful way to gain insights into development processes at neighbourhood level, in particular those associated with informal development that are common in many cities around the world. Micro-scale spatial models can be used to examine scenarios of possible future growth and development, i.e. the classic “what-if?” types of question that are often posed by urban planners but may be impossible to answer effectively with standard GIS functions. Various methods are used in our current research, such as the use of spatial statistics, cellular automata (CA) and agent-based models (ABMs). In the following paragraphs, we give some examples of how these methods are being used in current research.

Recent efforts have been oriented, among other instances, to support the planning and management capacities of the city of Kampala, Uganda. Possible future landscapes have been simulated to account for urban growth and its consequences on flood patterns. This work was conducted as part of a UN-HABITAT Cities and Climate Change Initiative project on Integrated Flood Management, executed together with Professor Victor Jetten and Dr David Rossiter of the ESA department, ITC alumni Dr Shuaib Lwasa and Dr John Wasige of Makerere University, and Dr Georg Petersen of Hydroconsult. The Upper Lubigi basin was modelled using statistical approaches (SLR: spatial logistic regression) and computational methods such as cellular automata (CA).

These results were used as inputs for a flood model (openLISEM), thus informing policy makers of the environmental impacts of land use policy. SLR is a multivariate statistical regression technique, relating a set of determinants (spatial factors) to a discrete dependent variable – a land cover category. CA models divide space into discrete units, cells, each of which is characterized by a state (in this case, land cover categories) and rules describing how this change evolves in time as a response to its surroundings (e.g. when a vegetation cell is surrounded by urban cells, it converts into urban itself). The possible futures, which for the target year 2020 reflected different possible population growth rates and policy interventions (e.g. the protection of wetland areas, the use of water barrels in many housing units to catch rainfall, changes to the main drainage channels), resulted in maps of the landscape (Figure 1) and of flooding (Figure 2) associated with this land cover configuration. Recommendations from the analysis included the implementation of defensive landscape strategies, especially regarding the protection and restoration of wetland areas; limited paving of the main drainage channel (since full paving would aggravate downstream flooding); and an assessment of the potential of elements from the sustainable urban drainage systems approach. These strategies and actions were

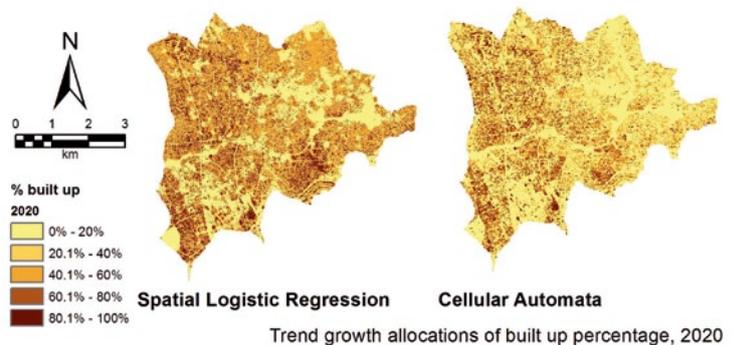


Figure 1 Maps of the landscape



Figure 2 Map of the flooding

developed during stakeholder workshops and presented at the Ugandan National Workshop on Cities and Climate Change in Kampala in December 2013 (Figure 3).

PGM is also developing agent-based models (ABMs) to simulate urban dynamics at micro-scale. An ABM is a simulation model in which decision makers are represented as goal-oriented entities capable of responding to their environment and taking autonomous action – in simple terms this means we model the land user rather than the land use itself. The use of land is therefore a product of human decision making and behaviour. ABMs can therefore be used to simulate evolving patterns of urban growth resulting from locational choices of large numbers of residents exercising their individual preferences. Consequently, an ABM is particularly suited – though as yet not very frequently applied – to model the growth of informal settlements and slums. This process is very much the consequence of more or less autonomous decisions taken by residents owing to weak statutory planning in the form of urban policies, land use plans and development control enforcement.

We have developed various ABMs simulating dynamics of urban growth in informal settlements of Dar es Salaam, Tanzania. For example, together with Ellen-Wien Augustijn-Beckers and Bas Retsios from the GIP department, a spatially explicit, vector-based ABM that simulates the growth of an informal settlement from 1967 to 1993 based on economic, social and physical factors was built (Figure 4). In this model the settler must be able to afford the location, is attracted to locations close to centres of economic activity, is likely to settle close to people with a similar background, and is trying to avoid wet areas and steep slopes (Figures 5 and 6). Currently, Johannes and Richard are working with Dr Nina Schwarz of the Helmholtz Centre for Environmental Research (UFZ) in Germany on an ABM to study the impacts of urban upgrading activities in selected informal settlements on infrastructure quality and social segregation within an entire city. This research draws on our knowledge and experiences in Dar es Salaam and other sub-Saharan African cities. We intend to develop and further explore how ABM simulations can inform urban policy and planning concerning informality in this region. ■



Figure 3 Participants at the CCCI workshop in Kampala develop ideas for actions to reduce flood risk

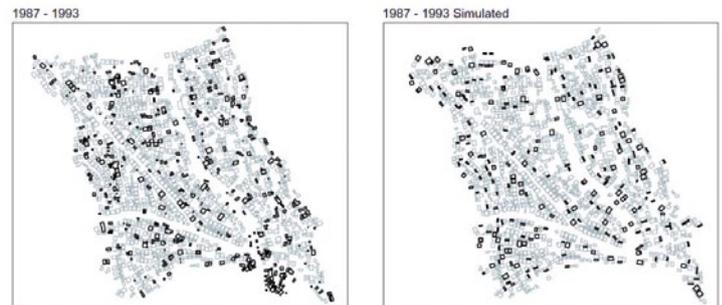


Figure 4 Outputs of ABM for part of Tandale informal settlement, Dar es Salaam – left: actual buildings constructed; right: simulated construction. (Source: Augustijn-Beckers, E. W., Flacke, J., & Retsios, B. (2011). Simulating informal settlement growth in Dar es Salaam, Tanzania: An agent-based housing model. *Computers, Environment and Urban Systems*, 35(2), 93-103

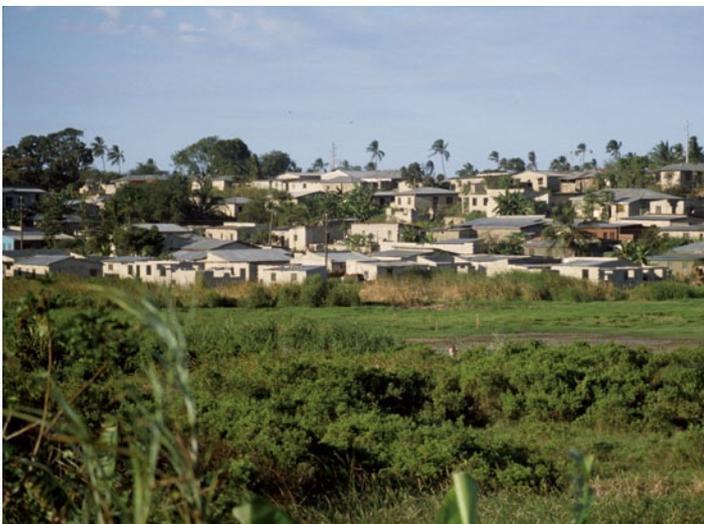


Figure 5 Ground photo of an informal settlement in Dar es Salaam showing house construction processes, including expansion into a wetland area (source: Sliuzas)



Figure 6 Aerial view contrasting informal and formal neighbourhoods in Dar es Salaam (source: Sliuzas)

Climate Change Adaptation Research Using Fuzzy Cognitive Mapping (FCM) in India

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Fuzzy cognitive mapping—a versatile tool for semi-quantitative climate change impact assessment, vulnerability and adaptation studies—models residents' experience with and perception of climate change events, yielding socially sensible adaptation options and rankings of most suitable planning alternatives.

Urban areas can be understood as socio-ecological systems (Olazabal & Reckien, 2015, forthcoming) where a high degree of complexity (and with it a large number of interacting stakeholders and potential management options (Maier et al., 2008)), a high degree of uncertainty (e.g. about future climate or environmental, social and political conditions), and a lack of appropriate data for assessing current or future states of the system converge. Next to complexity and uncertainty, data scarcity is particularly problematic when assessing and analysing urban systems. For example, when data for urban areas are absent, social system variables are important but difficult to define, and (social) indicators are scarce or difficult to measure (Reckien et al., 2011; Reckien et al., 2013).

In these complex but data-scarce environments novel methods of analysis are needed. Fuzzy cognitive mapping (FCM) is one such novel method and a powerful tool in environmental decision making and management, as it uses the understanding of stakeholders as data and attempts to capture the functioning of a complex system based on people's understanding and their belief systems. It is therefore a participatory scenario and analysis method (Reckien, 2014; Singh & Nair, 2014; Olazabal & Reckien, 2015, forthcoming).

FCM uses fuzzy-graph structures (resulting in fuzzy cognitive maps (FCMs)) that represent causal reasoning, allowing for systematic causal propagation (Kosko 1986; Kosko, 1994). FCMs consist of a set of nodes representing variables connected through links denoted by arrows (Harary et

al., 1965; Özesmi & Özesmi, 2004) (see Figure 1). Each variable represents characteristics of a system, while interconnections between the variables depict the causal dynamics of the system (Papageorgiou & Kontogianni, 2012). The variables could be physical, measurable entities as well as qualitative, aggregate or abstract ideas, including ethical, political or aesthetic issues (Reckien et al., 2011). Relationships between these variables are labelled with positive or negative polarities depicting an increasing or decreasing effect of the change of one variable on the other (Singh & Nair, 2014).

The causal graphs can be developed with single stakeholders or with groups of people (see Figure 3) in a situated or non-situated setting (see Figure 4), whereas single FCMs can also be aggregated to depict the understanding of multiple stakeholders, i.e. aggregated into so-called social maps (Özesmi & Özesmi, 2004). These causal graphs are then analysed according to network statistics (centrality, in-degree, out-degree, etc.) or content evaluation. Analysing the content of maps can, for example, yield the number of mentioned variables belonging to a certain sector (such as transport, health, etc.; Reckien, 2014) or be regarded as the sensitivity or adaptive capacity aspect (Singh & Nair, 2014; Singh & Nair, submitted). Scenario evaluation is another very powerful analysis option of FCMs via matrix multiplication, comparing the steady state of the original maps with modified ones, for example changing factor loads, weights of connections or number of variables (Figure 3).

FCMs are a versatile tool for climate change impact, adaptation (Reckien, 2014; Singh & Nair, forthcoming) and vulnerability studies (Singh & Nair, 2014), with multiple ways of capturing and analysing adaptation options and adaptive capacity to climate changes. Adaptation options can be implemented via (i) a modification of a given stakeholder map (e.g. by constantly setting the factor load of a variable to high or low throughout all iterations in the matrix multiplication, by changing the causal relationships (very rarely done as this is assumed to be valuable stakeholder knowledge) or by implementing new variables and their effects on the system, for example depicting new policies) or (ii) by asking stakeholders for their reaction to climatic and other changes. The latter approach simulates the adaptive capacity as part of the socio-ecological system, whereas the first approach evaluates hypothetical adaptation options.

The potential of FCMs for environmental decision making and management is high. For example, in a study of current impacts of heatwaves and heavy rainfall events in

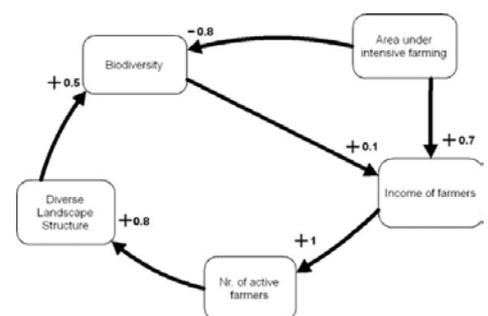


Figure 1 Hypothetical example of an FCM related to influences of biodiversity (credit: Martin Wildenberg)

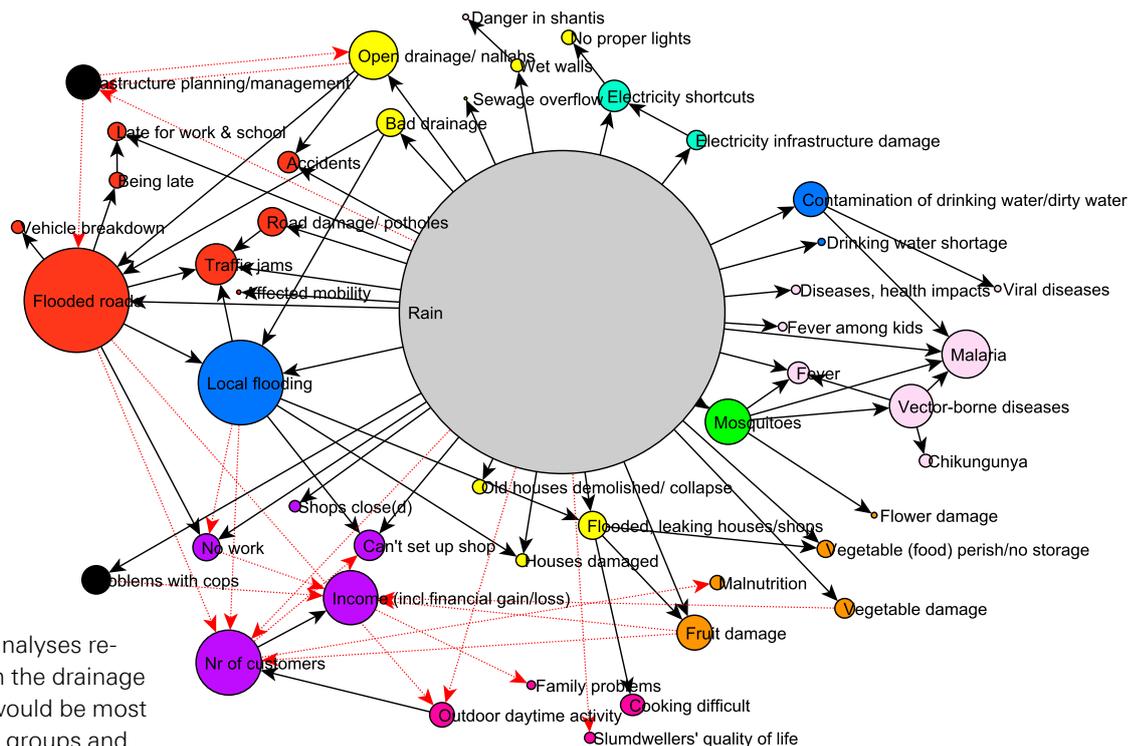


Figure 2 Real-world example of the respondents in the Old City of Hyderabad, India. The aggregated social map of all respondents concerning heavy rain events (Reckien et al., 2014, amended). Weights on connections are excluded for clarity; red arrows depict negative relationships; black arrows depict positive relationships. The size of node shows its centrality (i.e. the sum of in-coming and out-going weights on connections)

urban India, FCM scenario analyses revealed that improvements in the drainage and sewage infrastructure would be most beneficial for all stakeholder groups and across seasons in lowering the impacts of extreme events, although the traffic and health sectors were perceived as the most impacted sectors. FCM accounts for the interdependencies between variables in a complex system, thereby evaluating the root causes of a problem. Scenario analyses also evaluated the outcome of self-help options (i.e. reactive or autonomous adaptations) and revealed that these are not sufficient to reduce the impact of climate extreme events now and in the future. It was also revealed that heavy rain is more burdensome for the low-income groups, whereas heatwaves seem more burdensome for middle-income respondents if they are not planners and know of the burden for the poor (planners were asked to report the impacts on the city as a whole; Figure 5). Such results are useful for most successfully targeting infrastructure improvements, sectoral budgets, and social policies in urban areas, in order to increase the resilience of the whole urban system by accounting for the particular vulnerabilities of certain socio-economic groups.

Another study of the consequences of rising temperatures and increased rainfall variability in India revealed that financial and natural assets were the most sensitive, while organizational assets were most essential in providing resilience. Communities were most adversely affected during the summer and winter seasons, while the maximum number of autonomous and

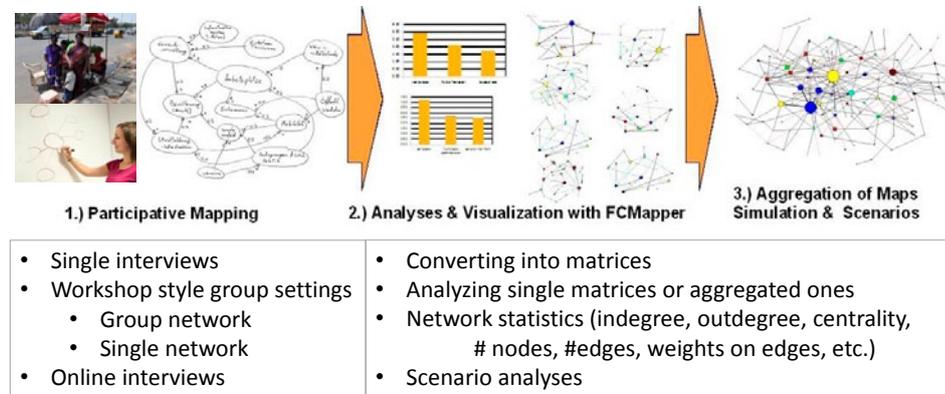


Figure 3 Procedure of FCM generation and analyses

reactive adaptations were deployed during the rainfall season to reduce sensitivities. The result of the study suggests that communities are indeed vulnerable to climate variability and change. Scenarios were generated to understand potential impacts of future climate change, along with best adaptation strategies scaled up to their maximum potential as deployed by communities. Results concluded that neither reactive nor autonomous adaptations were effective in enhancing resilience against future climate and change. It is imperative that communities deploy

adaptations that are incremental and transformative in the light of future climate change in order to ensure climate-resilient development.

Conclusion and Value for Urban Planning and Management

FCM proves to be a versatile method for evaluating, analysing and simulating complex systems, such as urban environments under climate change. Unlike other approaches, FCM does not require large datasets that are sometimes costly or even unavailable. FCMs use local contextual

knowledge – indispensable in local vulnerability and climate change adaptation studies; supplement and complement quantitative data with qualitative knowledge; and help to understand issues related to human behaviour, such as climate change adaptation and adaptive capacity (Singh & Nair, 2014; Reckien et al., 2011).

FCM yields relative values that act as the representation of a belief system while providing relative indicators to policy circles. This not only supplements findings in areas lacking quantitative data but also helps to compare people’s perceptions of quantitative data and acts as a powerful tool for understanding human behaviour. Such studies can open up new avenues for research, including understanding the insecurities of people due to environmental stressors such as climate change. ■

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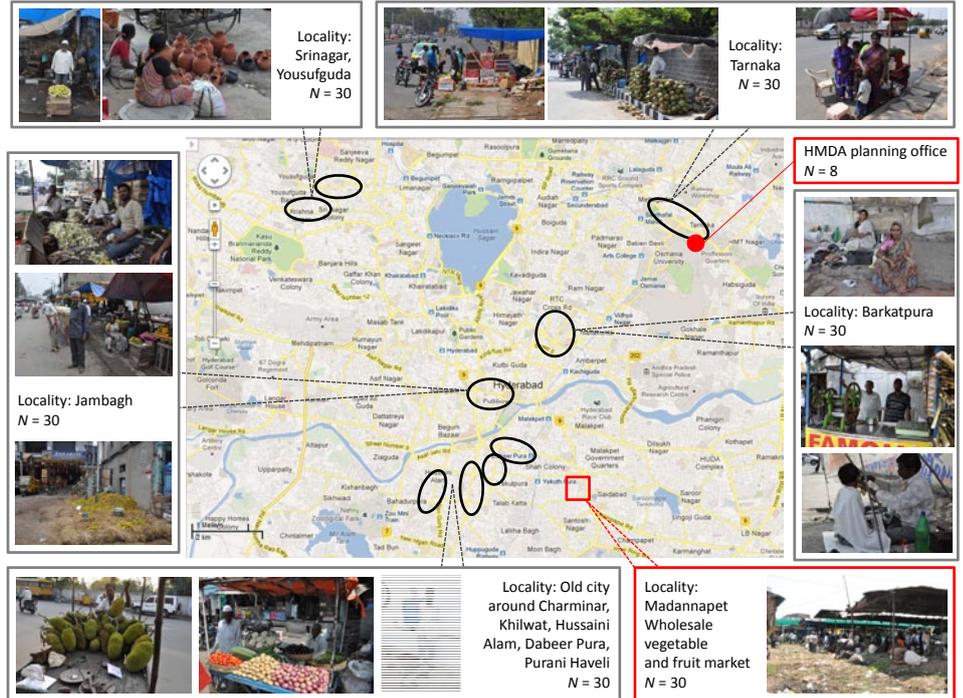


Figure 4 Interview places and interviewees in Hyderabad, India. All interview settings apart from the HMDA refer to a situational approach, where people are interviewed in their context related to the research question. Planners at the HMDA were interviewed in a non-situational approach (i.e. about impacts of climate change events on the urban environment in their offices). Interview settings in red boxes refer to medium-income respondents; interview settings in black boxes point to low-income respondents. (Sources: Google Inc., Reckien et al., 2014, amended.)

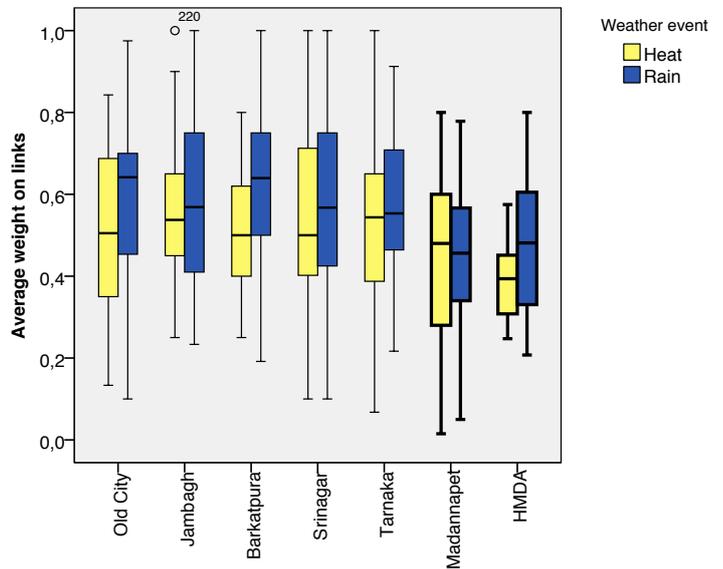


Figure 5 The average strength of causal relations in the networks across localities and stakeholder groups. Boxes with thick lines refer to medium-income respondents. (Source: Reckien et al., 2014, amended.)

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Slum Mapping

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As many cities in the global South are faced with both the rapid growth of existing slums and the emergence of new slums, which sometimes house more than 50% of the urban inhabitants, the development of efficient and effective methods for slum mapping continues to be an important issue for the PGM department. While the production of slum maps from conventional large-format aerial photographs and field surveys is still done, other options are also now being developed through our research activities. Two examples of current work are the use of geographic object-based image analysis (GEOBIA) methods, together with today's very high resolution (VHR) satellite images, and the production of slum maps from even higher resolution images (<10 cm) collected by an unmanned aerial vehicle (UAV), which is a remotely controlled miniature aircraft equipped with a lightweight, small-format digital camera.

For more than a decade, VHR imagery from space-borne sensors has been available. Recently, the first imagery at a spatial resolution of 30 cm became available, allowing an improved object-based image analysis, as well as providing in general more spatial details for semi-automatic mapping approaches. A common focus is the extraction of urban structural types, such as slum versus formal built-up areas. In many cities, essential base information on the location, dynamics and spatial extent of slum areas is missing or outdated, but it is essential for planning, interventions, better targeting of pro-poor policies and monitoring policy implementation.

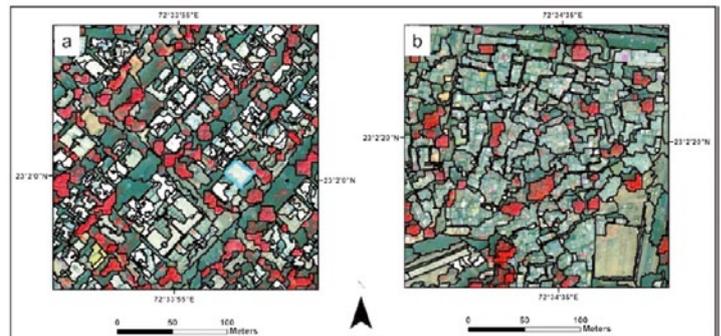


Figure 1 Image segmentations of a planned neighbourhood (a) and a slum (b) from object-based image analysis in Ahmedabad, India (Kohli, Warwadekar, Kerle, Sliuzas, & Stein, 2013)

Using VHR imagery, we aim to extract object-level information (Figure 1) that can be either used for detailed analysis at building level or aggregated to settlement level for mapping purposes. Building-object-level analysis could for example be used for slum population estimations, because slums may not be well covered by census statistics. Such population estimation models can also be refined by the use of 3D building information, for example extracted from VHR stereo imageries (Figure 2).

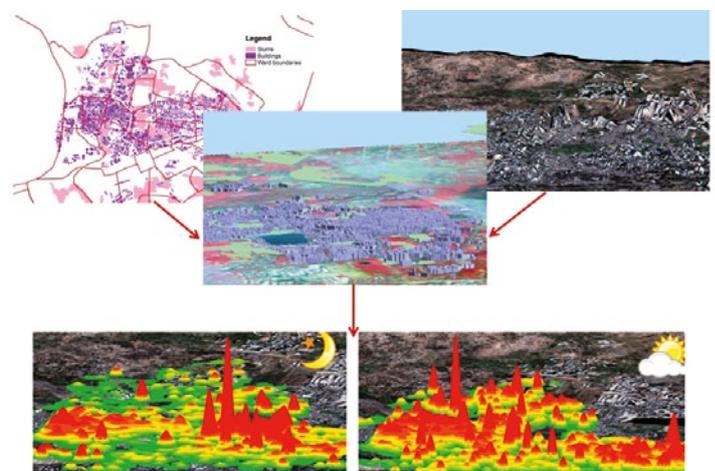


Figure 2 Modelling night-time (left) and day-time (right) population using a 3D urban model (Kuffer & Sliuzas, 2014)

A recent research line within the PGM department is the use of machine learning methods to map slums in Mumbai (Figure 3, page 12) using a set of indicators (spatial proxies). Spatial proxies aim to model the main physical characteristics of slums, i.e. high densities, small building sizes, organic patterns and location aspects (e.g. proximity to hazards). Thus such proxies can be based on spectral input or texture layers, but also additional layers, for example from volunteered geographical information (VGI), can be added to improve mapping accuracies. Here it is important that the method can incorporate a variety of different slum types (Figure 4, page 12).

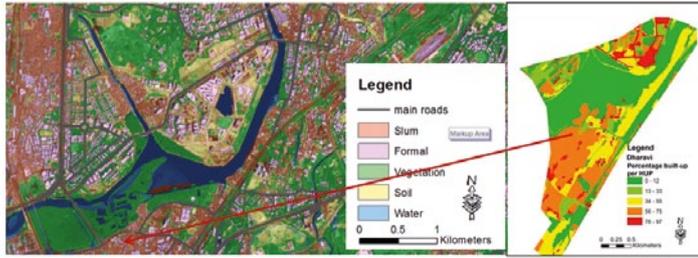


Figure 3 Random forest classification of slum and formal built-up areas (left), built-up density of Dharavi ward (Mumbai) extracted via image segmentation (Kuffer, Sliuzas, Pfeffer, & Baud, 2015)

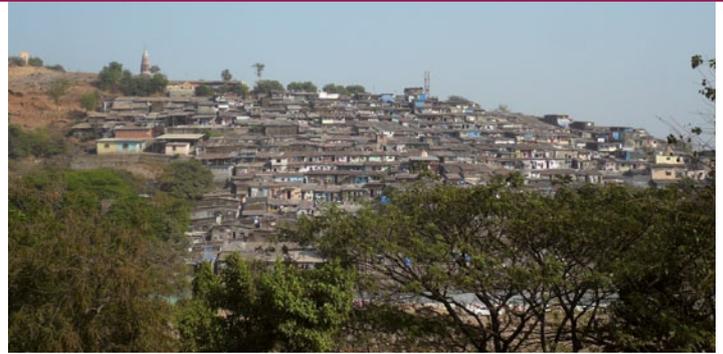


Figure 4 Two contrasting views of slums in Mumbai (source: Karin Pfeffer, UvA)

Caroline Gevaert's PhD project on the use of UAVs in slum mapping, supervised by Professor George Vosselman and Claudio Persello of the EOS department and Richard Sliuzas, started in September 2014. Her research explores how to improve the accuracy of data extraction and high-resolution 2D and 3D spatial models for slum areas derived from a low-cost UAV platform. She will also examine how such methods and products satisfy and influence stakeholders' information requirements in slum upgrading projects. With the support of Kigali City, with whom PGM has a research cooperation agreement, Caroline was able to acquire more than 15,000 UAV images, covering three informal settlements with a total area of about 150 ha.



Caroline preparing the UAV for flight

The figures give impressions of the operations of the UAV, the type of data acquired and some initial products that may be derived. When ready, the 2D and 3D products will be made available to Kigali City and resident groups for use in the settlement upgrading process. There are considerable technical challenges in processing the large number of images required to produce the level of accuracy required for the high-quality products needed by users. However, we are confident that these will be overcome and we think that there will be increasing use made of UAV data acquisition systems, even in urban areas. The work of Caroline and others in this field may be of great importance for future slum upgrading projects around the world.



Single UAV image of Agatare settlement, Kigali, on 22 May 2015, captured with a DJI Phantom 2 Vision+ UAV using a fisheye lens, which produces massive image distortion



Part of a 3D model of Agatare settlement produced from a series of overlapping UAV images

Equity-Based Resource Allocation for Infrastructure Development

Decisions on Financing Infrastructure in Indonesia

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Infrastructure systems are expensive. Providing the fast-growing urban and the often remote rural populations with a minimum level of infrastructure is a challenge in many countries.

Governments are looking for more successful and sustainable ways to finance infrastructure than has been the case in the past. In order to do this, policies on resource allocation for infrastructure development become essential, particularly in developing countries where budgets are severely constrained. The key question in resource allocation is how can we best spend our limited and insufficient resources to achieve the maximum effect. In other words, what type of infrastructure investment needs to be done, at which location and when?

In Indonesia this issue is very pressing indeed, as many people in remote and under-served areas, as well as many urban poor, are disadvantaged by a low level of services that hampers their prospects for economic development. Therefore, Indonesia is currently mainstreaming policies to be pro-poor (directed at achieving equity and favouring the poor), pro-growth (directed towards increasing economic growth) and pro-job (directed towards increasing employment opportunities).

Achieving these policy outputs, however, is a difficult problem. How do you evaluate the effect of your infrastructure resource allocation? Does the investment really benefit the poor more than the rich? Does it lead to growth and jobs? How can resources be optimally allocated to achieve the best outcome? Some attempts to evaluate the impact of resource allocation policies have been made, but a comprehensive and systematic framework for executing and evaluating these policies in a consistent manner does not exist at the moment. The current research addresses this problem.

In this research, an evaluation framework has been developed that is based on infrastructure-led economic opportunity. We are looking at four types of infrastructure (water, electricity, telecommunication and transportation) in the central province of Yogyakarta, Indonesia. The unit of analysis is the village, either rural or urban. The province consists of 438 villages (Figure 1).

To evaluate future effects of infrastructure resource allocation on economic opportunity, we have developed three models. The first defines economic opportunity in a village as a function of available infrastructure within that village. The second model includes the effect of economic opportunity in neighbouring villages in addition to available infrastructure within the village. In the third model, we include the interdependency of infrastructures as another factor affecting the potential level of economic development in the village.

We use ordinary least squares (OLS) and a geographic information system (GIS) to model the first concept, and we add a spatial-lag model for the second. The third model expands on the second by introducing a Sugeno fuzzy inference system (FIS) and a rule-based OLS to capture the nature of infrastructure interdependency.

Figure 2 (page 14) provides the basic levels of service in the province. The dark colours represent higher values or better infrastructure performance. It is interesting to note the similarity in the pattern of performance of electricity, telecommunication and water, where the urban villages of Yogyakarta city and surroundings score much higher levels than the more rural areas in

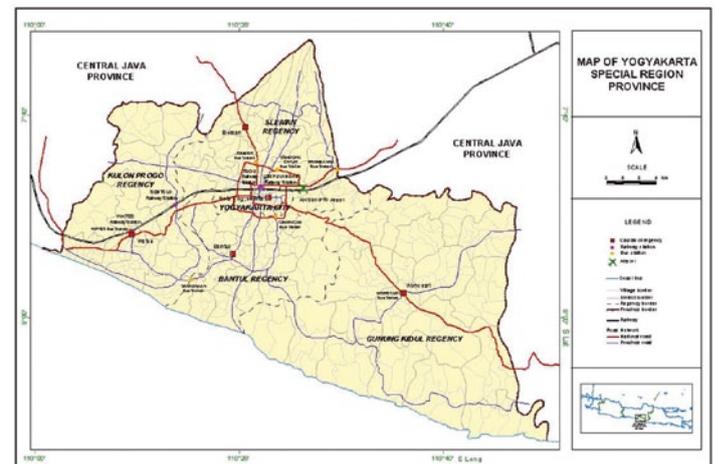


Figure 1 Special Region of Yogyakarta

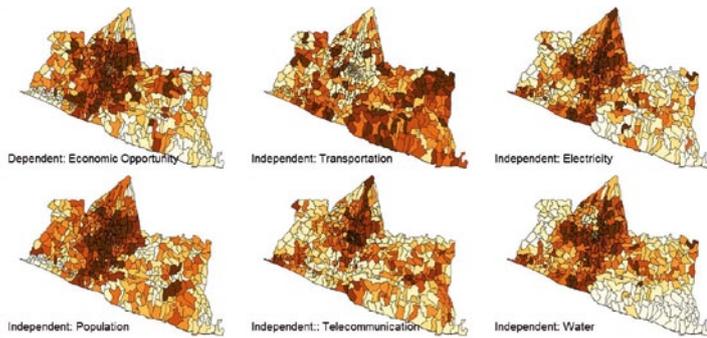


Figure 2 Baseline spatial distribution of independent variables of infrastructure performance

the east of the province. The situation with transport is the reverse, as congestion levels in the city reduce transport system performance considerably.

Figure 3 explains the concepts of models 1 and 2. The second model uses the performance of infrastructure in the surrounding villages to calculate economic opportunity.

The result maps of the three models are given in Figure 4. Based on validation with a known dataset that measures economic opportunity and wellbeing, the results demonstrate that the third model provides a more accurate prediction of the real conditions and performs consistently better than the other two models. We therefore conclude that conditions in neighbouring villages and infrastructure interdependency influence the economic opportunity of a village and should be considered in policy making regarding resource allocation in infrastructure development.

Learning from the importance to take into account neighbourhood factors in infrastructure development, we carry out an experiment to find the most equitable resource location-allocation mechanism. We do this for the transport sector, where for each village the total opportunity of mobility is calculated to set the expected target growth. Here, additional resources are allocated according to two types of modelling, a spatial preference model and a non-spatial preference model. For each of them, 10 % of growth is equally allocated. The results of these models are compared using a neighbourhood comparison.

The maps (Figure 5) demonstrate that the spatial preference model consistently directs the allocation to the locations with gaps among neighbourhood units, and therefore is more effective in addressing inequity in the whole region (as indicated by a higher index of spatial equity (I) and also more clusters of villages with high performance surrounded by high performance).

We conclude that the inclusion of a neighbourhood comparison in spatial preference modelling provides a more equitable resource location-allocation than non-spatial preference modelling. The spatial preference model also provides an alternative way to accommodate the need for an efficiency-equity trade-off in a diverse region, such as the Special Province of Yogyakarta in Indonesia. This approach allows public officials to apply social and spatial equity criteria for decision making.

Further steps in this research will be related to the development of a decision support system concept and its implementation, which provide for a new systematic approach to resource allocation that can be implemented in a GIS environment to support decision makers in distributing limited resources in an equitable manner. ■

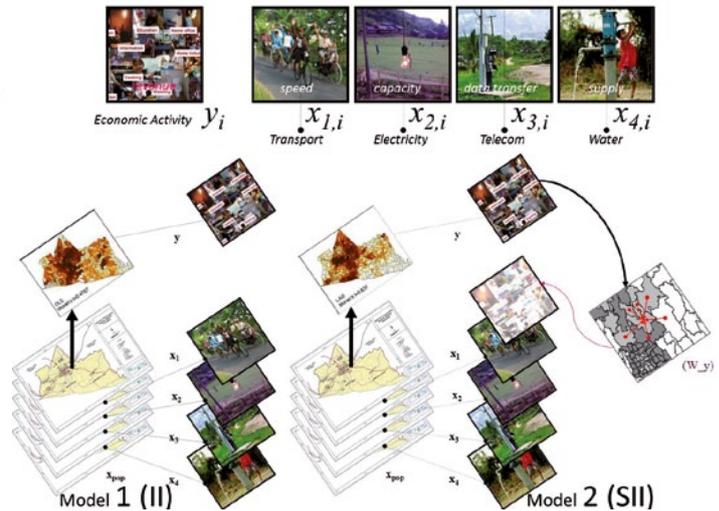


Figure 3 Concept of the classical model 1 and the spatial-lag model 2

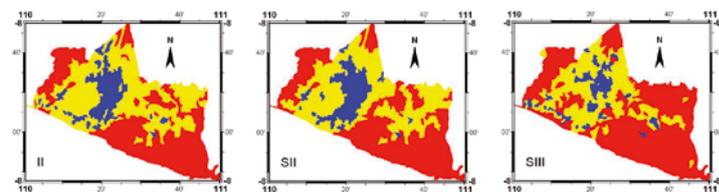


Figure 4 Economic opportunity based on the three models. Blue indicates a high level, yellow a medium level and red a low level of economic opportunity

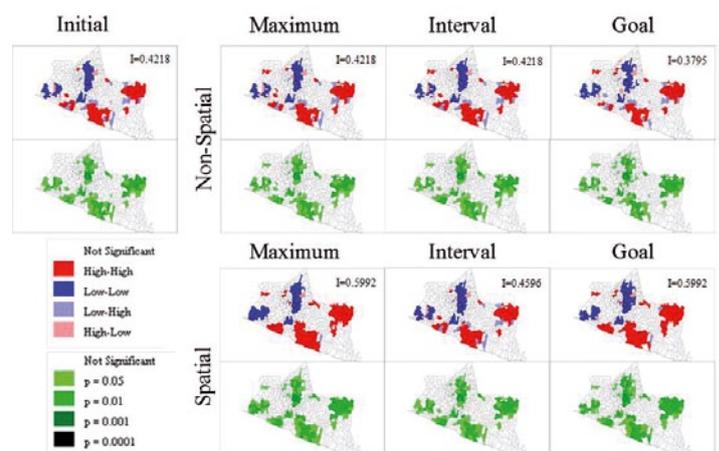


Figure 5 The spatial preference model consistently directs the allocation to the locations with gaps among neighbourhood units

FURTHER INFORMATION:

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Designing Bicycle Infrastructure

Spatial Multicriteria Assessment of Bicycle Routes in Christchurch, New Zealand

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Many cities in New Zealand are investing heavily in cycling infrastructure. Christchurch in particular is rebuilding its infrastructure after the 2010 and 2011 earthquakes and is developing an extensive cycle way programme. The development of this public infrastructure is accompanied by all kinds of spatial decision-making problems, such as which locations and communities to serve, which routes to develop, which designs to be made in which environments, and so on and so forth. These problems are inherently complex due to physical limitations, finite resources, the involvement of multiple parties and their mixed interests. For this reason, decision makers use policy-driven and objective-based criteria to evaluate options such as route alternatives in order to help them compare and prioritize projects that are most suitable to their needs.

To better support this kind of decision making, this research is working towards the creation of a bicycle route assessment method that can incorporate demand and supply data for input into a participatory spatial decision support system (SDSS), with a test of its application in Christchurch, New Zealand (Figure 1).

To this end, an assessment framework has been developed that is responsive to the needs and preferences of different target cyclist groups as identified by policy makers. These groups are current cyclist commuters, potential cyclist commuters, and parents of children aged 10-17. Each Christchurch target group was ana-

lysed in terms of current mobility patterns and feelings in regard to cycling in their neighbourhood. Census results and July 2014 surveys revealed the population to be relatively unresponsive to the efforts of past cycling programmes. Many Christchurch residents believe they live within cycling distance of work/study, but the car remains their main mode of transportation. Stakeholder analysis revealed public dissatisfaction with Christchurch's current cycling programme and difficulties with current roadway design (see Figure 2 for an illustration of current behaviour and Figure 3 (page 16) for an example of confusing roadway design). A variety of improvements were suggested related to behaviour,

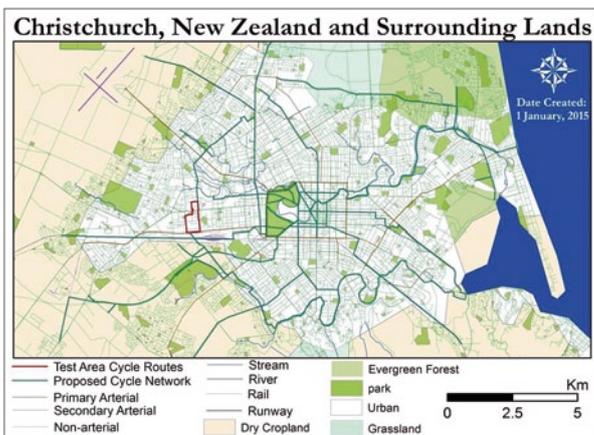


Figure 1 Map of Christchurch and its proposed cycling infrastructure



Figure 2 Cyclist on the sidewalk in the absence of proper infrastructure



Figure 3 Confusing infrastructure for the user

connectivity, maintenance, present facilities, current design and navigation, as well as to address obstructions/poor visibility. These factors have been taken into account in the SDSS criteria and subcriteria.

Subsequently, the needs and preferences with regard to various bicycle-friendly ideals and bicycle infrastructure characteristics are ranked, and aggregated group preference sets are turned into weights and applied to roadway performance measures.

Figure 4 shows the study area with the two routes compared. By using 11 subcriteria and six criteria to score each segment and each junction, respectively, overall route scores are derived and the best route can be chosen. Obviously the scores depend on the user perspective taken and the associated weights applied.

More interestingly, Figure 5 shows a detailed picture of the performance of the individual subcriteria along the roadway. This allows infrastructure project designers to determine where scores are below acceptable thresholds and where the most severe problems in the route occur. The outputs of the assessment give detailed information that can be used to see how much overall bicycle-friendliness benefits after the worst-scoring route components are targeted with improvement projects. This also allows a forecast to be made of how much an investment is likely to improve the bicycle-friendliness of any given junction, segment, or route.

The results confirm route assessments must take into consideration the proper scale and detail at which they should be applied. Small areas require only junction and segment assessment, while large areas are suitable for route or network-level assessment. All of these are possible with the scalable formulas and spatial aggregation options inherent in the SDSS.

The proposed SDSS can be a very powerful tool for planners, designers and decision makers in providing a platform for the application of quantitative and spatial standards proposed by regional and national policy makers, improving the overall quality of urban bicycle networks in New Zealand and elsewhere. ■

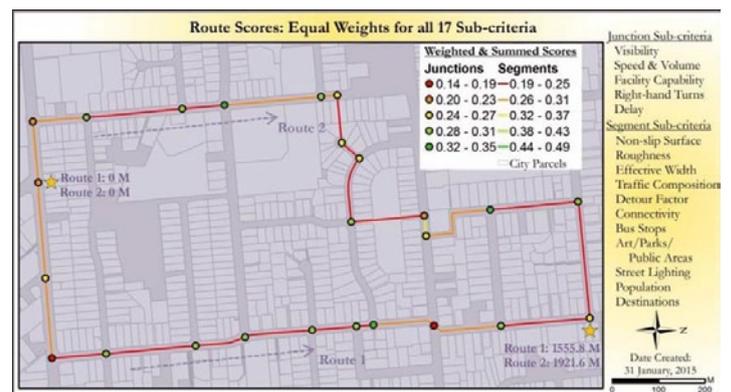


Figure 4 Route scores of multicriteria route assessment with equal weights

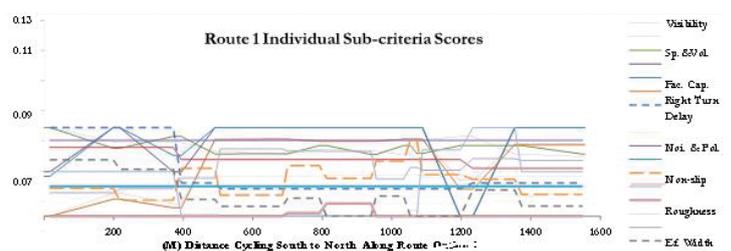


Figure 5 Detailed scores of subcriteria along one of the routes

Geo-ICT in the Public Health Domain

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As one of the leading global trends of the 21st century, urbanization has a significant impact on health status and healthcare provision in cities. Important factors influencing urban health include governance, population characteristics, the natural and built environment, social and economic development, and food security on the one hand, and access to adequate and affordable health services on the other. Improving urban health and healthcare services, and reducing intra-urban health disparities remain at the forefront of government priorities throughout the world. Academic institutions, government agencies and other stakeholders increasingly use spatial data and geo-information technology (Geo-ICT) to analyse access to primary health services, identify and understand geographical variations in health status and disease occurrence, and more generally monitor and map health trends. In recent years, the pace of adoption of geospatial tools and techniques in the public health domain has been accelerating.

To realize the full potential of Geo-ICT in the public health domain, however, further steps are required. The challenge will be to make effective use of data of high spatial and temporal resolution, and develop spatial modelling methods and forecasting techniques to generate essential information that can be used for optimal resource allocation, risk-based monitoring and the development of effective intervention strategies. Another challenge will be to raise awareness among policy and decision makers of the capabilities of Geo-ICT. At ITC, scientists from different departments are increasingly engaged and collaborate in this relatively new and dynamic interdisciplinary academic field.

The health theme within the PGM department, in general terms, aims to improve understanding of the relationships between people, location, time and health. Important focus areas are the understanding of socio-spatial patterns of health-seeking behaviour, analysis of intra-urban health inequities, and accessibility modelling of public healthcare systems. The overall aim is to strengthen the effectiveness and efficiency of health services delivery, reduce health inequities, and improve the health status of city citizens.

Over the past years, substantial MSc research work has been undertaken to assess the performance of public healthcare systems in a variety of countries.

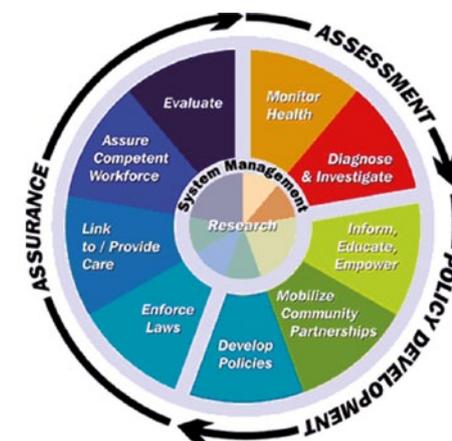
For example, Murekatete (2010) evaluated access to primary healthcare in Kigali, Rwanda. Ingabire (2014) built on this research and evaluated access to secondary and tertiary healthcare in the same city. The outcomes of both studies indicate that the Rwandan public healthcare system has made extraordinary progress in establishing an affordable, patient-oriented and credible public healthcare system since the initiation of health system reforms in 1999. Within the city, geographical accessibility to medical care is unproblematic overall, with shortcomings in some of the more peripheral neighbourhoods. Both studies also indicate that constrained medical staff availability remains a challenge within the Kigali public healthcare system. Studies such as these illustrate how small-scale

MSc research can result in very useful insights.

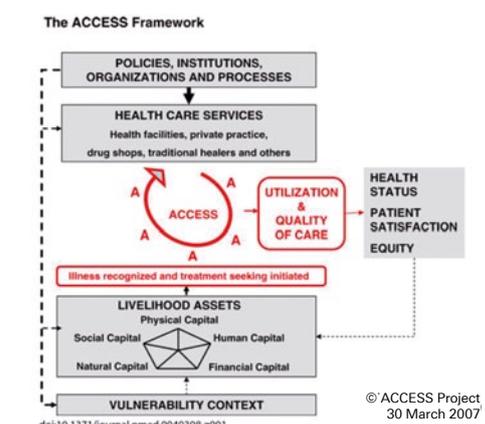
More recently, PGM has also engaged in PhD-level research in the health domain. PhD candidate Elias Nyandwi is focusing



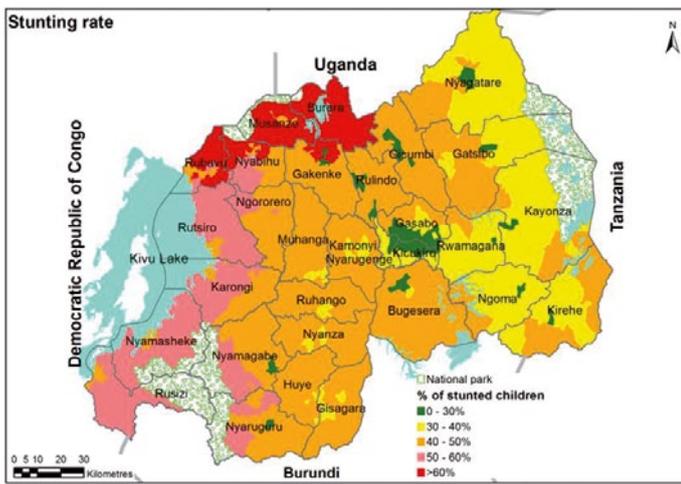
Primary health care facility Kigali



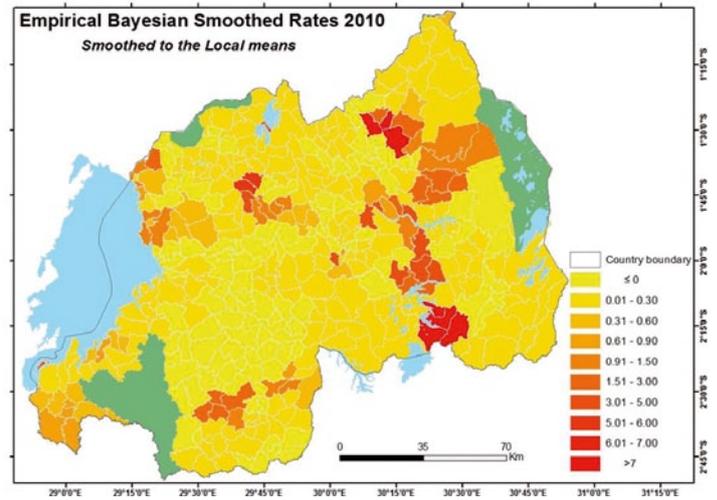
Sequence of health planning process



Examples of MSc research on Kigali health care



Stunting rate in Rwanda per district in 2013. Source: Based on data from the Comprehensive Food Security and Vulnerability Analysis (2013)



Schistosomiasis in Rwanda per health facility catchment area in 2010.

on the spatial modelling of risk factors for helminth infections. PhD candidate Vestine Uwiringiyimana is investigating the extent to which dietary zinc intake and mycotoxins exposure relates to stunting. In collaboration with the Royal Tropical Institute, PGM is also involved in research on spatial risk factors regarding malaria infection.

The overall aim of the health theme in PGM is to further extend its expertise in the coming years and deliver MSc and PhD graduates with the critical understanding, technical capability and scientific competence to address important public health challenges, using geo-information science and earth observation. Clear linkages exist

with other research themes within PGM (i.e. quality of life, climate change, disaster management) and other ITC departments.

Interested in training, education or research in Geo-ICT and urban health? Please contact s.amer@utwente.nl

Quality of Life, Community Wellbeing and Co-production of Knowledge

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There is increasing interest in achieving more equitable, cohesive and sustainable urban areas. An important element of this concern relates to improving our understanding of spatial variations in quality-of-life conditions within and across communities. Quality of life is one of the key elements stimulating prosperity in cities (UN-Habitat, 2012). It is recognized that the wellbeing and progress of communities goes beyond economic growth, encompassing multiple dimensions. Eliciting how people perceive these multiple dimensions of quality of life and wellbeing is central to progressive forms of inclusive urban development and planning.

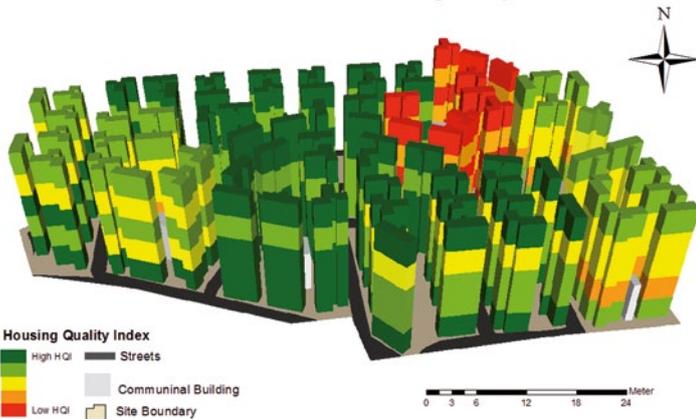
Within the Urban Planning and Management course and several refresher courses, we have been teaching different methods and techniques/tools to (co-)produce knowledge on quality of life and community wellbeing – including participatory GIS (PGIS), qualitative GIS, walking interviews, and other forms of participatory data collection methods involving mobile and online communications, such as crowd sourcing and volunteered geographical information (VGI). This has resulted in the application of these approaches in published research (scientific and professional publications) and several MSc theses during the last five years.





Participatory mapping using mobile GIS tools

Gotera Condominium Housing Quality Index



3D differentiation in quality of life in condominiums in Addis Abeba
(source: Tigist Ayele Gebrewold, 2015)



Improving quality of life in Enschede (source: www.wesselerbrinknoord.nl)

From these studies, we know that a better understanding of quality of life in urban areas and the monitoring of unequal conditions are of interest to policy makers to enable them to better target and reallocate resources to the most disadvantaged areas. Quality-of-life studies enable the identification of wellbeing and deprived areas (Tesfazghi, Martínez, & Verplanke, 2010), which is often required for planning and area-based policies. By applying mixed methods (including qualitative GIS), we elicited the views of women garment workers in Dhaka (Bangladesh) and learned how quality of life was affected by the walking conditions of the routes they take from home to work (Shumi, Zuidgeest, Martínez, Efroymson, & van Maarseveen, 2014). In Ethiopia, we have also used qualitative GIS and participatory methods to understand and identify why the quality-of-life conditions as measured by planners and indicators may diverge from those perceived by residents (Berhe, Martínez, & Verplanke, 2014).

Our students have also applied quality-of-life and co-production of knowledge methods in case studies carried out within the region of Twente and in Enschede in particular. We have worked with issues such as children's perception of the built environment, the use of green areas by students, and the quality of life at neighbourhood level in Enschede-Wesselerbrink.

As the urbanization of the world is posing new challenges in terms of unequal quality-of-life conditions, and knowledge production is no longer an exclusive domain of planners but also extends to residents, we are confident that teaching and learning (participatory) community wellbeing approaches and perspectives is central to preparing future planners capable of producing knowledge that contributes to inclusive urban development. ■

If you are interested in knowing more about the studies, please do not hesitate to contact us at j.martinez@utwente.nl or j.j.verplanke@utwente.nl

Urban Planning and Management at ITC

A Restructured Programme with a Stronger International Global Orientation

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The Urban Planning and Management (UPM) MSc course in its present set-up has been implemented at ITC quite successfully since 2006, with around 25 participants each year. Last year a review was undertaken to ensure that the curriculum remains attractive, up to date and relevant within an international context. Part of the review consisted of a consultation with UPM alumni about their experience in UPM at ITC.

Most UPM alumni endorsed the added value of the programme, i.e. the use and application of geographical information in urban planning and management. The use and application of geographical information to analyse, plan and manage the challenges of cities and regions was repeatedly mentioned as the clear niche of the UPM course at ITC. Alumni very much appreciated the balance between practice and theory in the course. They felt that future students should come to ITC to learn advanced use and new developments in GIS and remote sensing technologies and methods for urban planning management. At the same time, the course should provide sufficient insight into relevant academic developments in the theory of spatial policy and planning.

The real-world orientation coupled with the learning of practical skills is seen as an asset of the curriculum. It was repeatedly suggested that the use of real-world experiences through case studies, research on location, study trips, guest speakers and internships should not only be maintained but also expanded. Learning academic skills and critical thinking were explicitly mentioned a number of times as course assets.

Finally, it became very clear that the applicability of the course for developing countries and the international learning environment were very much appreciated by the alumni. They reiterated various times that these elements should be maintained and further enhanced.

This positive feedback from alumni (for some quotes see below), coupled with consultation of the international development and research agenda, review of similar curricula, and discussions among staff and students, has led to a restructured UPM curriculum for 2015-2017.

Furthermore, because we see that our alumni (as researchers, policy makers or consultants) operate more and more in an environment strongly influenced by international development debates, the restructured and reframed 2015-2017 curriculum has a much stronger orientation towards the urban themes and issues featured in the international development and research agenda.

By working on a certain thematic area in the restructured curriculum, students will become familiar with theories and concepts that are relevant to that area and learn to speak the right language. In the different modules, different disciplinary perspectives of Urban Planning, Urban Geography, Transport Planning, Engineering, Economics and Land administration will be offered to the students.

The restructured part of the curriculum, i.e. the part dealing explicitly with urban planning and management (seven 3-week modules of the 18-month MSc curriculum), will start with a module discussing the urban planning and policy process, the roles of different actors in this process, and the use of spatial methods and techniques. This introductory module will be followed

by a set of modules each emphasizing the city from a different perspective, namely

- The Sustainable City
- The Inclusive City
- The Competitive City
- The Compact City
- The Resilient City.

In each of the above modules, the course will address the various perspectives coupled with the use of relevant spatial analytical and decision support methods and tools. In a concluding project, students will work in groups on a real-world urban planning and management problem. They will have to demonstrate that they are able to analyse independently the spatial challenges of a city region and come up with alternative spatial courses of action, making appropriate use of spatial information technology, models and concepts.

With this restructured UPM curriculum, we expect students to be able to operate in a critical manner in an increasingly global environment. We hope to welcome many new students to the UPM course at ITC in the future. ■

MORE INFORMATION:

<http://www.itc.nl/C16-UPM-MSc-01>



UPM alumnus Inah Okon from Nigeria evaluating bicycle infrastructure in Bogota, Colombia, as part of his MSc research

SOME QUOTES FROM UPM ALUMNI

■ “The course gave me enough exposure in land-use- and transport-related issues and how to consider these parameters in any urban planning instance. Again, this is the place where GIS and its applications can be best learnt.”

■ “The UPM course at ITC provides students with the best tools, knowledge and skills to solve the most pressing issues related to city and regional planning, leading to an improved quality of life for citizens, especially in developing countries.”

■ “ITC is a great platform from which to interact with a widely extensive faculty across sectors and it is up to the candidate to capture and learn from everyone. Share and learn and unlearn – and the sharing of experiences is great. The faculty is very aggressive in encouraging the candidates to really think about and appreciate the creativity. International exposure is great!”

■ “State-of-the-art technology when it comes to GIS and RS software used in practical work.”

■ “UPM has a wide scope, which is very suitable for somebody who likes to extend their knowledge across many fields and somebody who is eager to see the bigger picture of the knowledge.”

■ “The programme is a blend of both theory and practice. It offers the students not only the knowledge of what to do (in urban planning) but also how to do it in practice!”

Planning for Transit-Oriented Development

Yamini J. Singh

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By quantifying transit-oriented development (TOD) in the form of an index, an innovative TOD planning strategy has been showcased that uses various geographic Information systems (GIS) to analyse and simulate TOD conditions in an area.

For about two decades now, planners across the world have been planning for transit-oriented development (TOD) in different urban and regional areas. However, TOD is gaining even more popularity in current times, in developed as well as developing nations. This study is thus relevant and topical as regards urban planning, especially TOD planning. Studies suggest that, in order to plan for TOD, planners recognize the need to be able to measure it. Like density, land use diversity, compactness of development, walkability and other such urban characteristics, we need to be able to measure the transit-orientedness of a development (TOD-ness). We need a measure that we can use to express “how transit-oriented the development in an area is”. However, until recently there was no such scientific measure ... not until the development of a TOD Index.

For the first time, a TOD index has been used to express the transit-orientation of the development in an area. Such an expression is highly necessary because it helps us to identify areas of high/low TOD-ness. When it comes to TOD planning, we can then focus our attention on only those specific areas that need it, thereby saving precious public resources. The TOD index measures various TOD characteristics together to represent or quantify the transit-orientation of an area. Since the TOD characteristics are spatial, non-spatial, diverse and have different units of measurement, it is imperative to employ the strengths of GIS and (spatial) multicriteria assessment ((S)MCA) to achieve our objective. For each area, different TOD characteristics or indicators are measured, first individually and then together to arrive at a TOD index value for that area. This value represents the com-

prehensive transit orientation of the development in that area. In the case of the City Region Arnhem and Nijmegen in the Netherlands, TOD was studied across the region (regional scale) and around the transit nodes, i.e. the train stations in the region (local scale). Stakeholder participation played a significant role in computing the TOD Index during the SMCA/MCA processes at both regional and local scale. Workshops were held in Nijmegen with the municipal heads or aldermen to gain a better understanding of their needs and priorities.

At the regional scale, the entire city region, covering 20 municipalities and about 1,000 km², was divided into smaller grid cells and the TOD index was calculated for each grid cell using GIS and SMCA. The hot spots of high TOD index values were then located in the region using spatial statistical analyses. It would make perfect sense to provide these hot spots with access to high-quality transit so that their car usage is reduced, since these areas already have higher transit orientation. Most of these hot spots were found to be located near nodes of the existing rail-based system in the region. For those hot spots that do not have such access to high-quality transit, it is suggested that a bus-based BRT system is planned, as it is cheaper than extending the rail-based system. In this manner, the transit orientation of different areas across the region was studied, measured and compared for the first time.

At local scale, the 21 stations of the rail-based national and regional transit system falling within the case study area were considered. TOD characteristics are measured along with the transit characteristics within a 10-minute walking distance



Yamini Singh

(800 m) of a station, because only an attractive transit service can create a TOD environment. Collectively, all transit and TOD characteristics are measured to arrive at a TOD index value for each station using GIS and MCA. For the first time, again, it was possible to compare different station areas and say which station area was more or less transit-oriented than others. The results were in line with the broad expectation that station areas in bigger cities will score higher than others and hence could be validated. The planners can then devote their resources to those station areas that score low.

New Method for Developing a Spatial Reconstruction Strategy to Stabilize and Develop the War-Torn Region of Darfur

Luc Boerboom

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Even though peace in Darfur has not yet been restored, the first steps towards reconstruction of the Sudanese region have already been taken. The spatial development of the region should decrease dependence on emergency and humanitarian aid. However, owing to years of war during which people have sought refuge in cities, functions in these cities have become overburdened.

Moreover, interdependencies within the network of settlements have become unbalanced or even unknown. Hence a strategic understanding of the region, indicating the strengths and weaknesses of clusters of settlements and infrastructure corridors, has been lacking. Consequently, strategic spending of the 3.4 billion euro reconstruction fund, pledged at the Darfur donor conference in 2013, has become very difficult.

Dr Luc Boerboom, assistant professor of Spatial Planning and Decision Support Systems and Infrastructures at the Department of Urban and Regional Planning and Geo-Information Management, was commissioned by UN-Habitat to co-develop the Spatial Development Framework (SDF) Methodology (Figure 1). Using this methodology, the team assisted in the creation of a shared vision for the spatial development of Darfur (Figure 2). The results are presented in a report entitled *Regional Spatial Planning Strategy of Darfur. Peace Building, Recovery and Development of Darfur: The Urban Factor*, which is published by the Government of Sudan, UN-Habitat and USAID.

The methodology involves all stakeholders and assesses and aggregates existing (spatial) data, which made it fast and cheap. More important than the satisfaction of UN-Habitat was the satisfaction and approval of the Cabinet of Sudan, the region of Darfur, the states of Darfur and the donor community. UN-Habitat has now commissioned Dr Boerboom to refine and implement the methodology in studies in the Blue Nile Region of Sudan and for the implementation of the new National Urbanization policy in Rwanda. ■

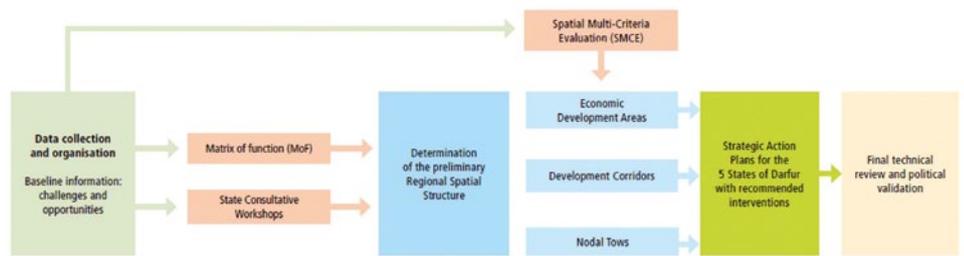


Figure 1 The Spatial Development Framework Methodology



Figure 2 Identified economic development areas, development corridors, and nodal towns

"My research assesses the association between wetland conversion and helminth infections in Rwanda. The starting point was to map and model wetlands and their use in time and space. After this, wetland use is correlated with helminth infections at a spatially disaggregate level, using routinely collected data from the Rwandan Health Management Information System.

Working on this transdisciplinary topic, I have to deal with various stakeholders (natural conservation, public health, agricultural development etc.). In concrete terms, my hypothesis is *Wetland conversion into intense agricultural use not only can contribute to the wellbeing of communities, but also increases exposure to helminths resulting in ill health.*

Involved stakeholders have very different perspectives. Agriculturalists tend to be in favour of intensified agricultural production to improve food security. Public health specialists on the other hand are more concerned with the increased health risks of such land use changes. Environmentalists, in turn, place emphasis on conservation and protection of biodiversity. Dealing with these conflicting perspectives is one of the practical challenges encountered during the implementation of this research project."

Elias Nyandwi
PhD candidate



"I am doing a multidisciplinary research at ITC. The goal of my research is to identify urban environmental factors influencing walking behaviour in older adults and to examine how these factors explain the gap between walking levels in older adults living in low- and high-deprivation urban areas. I integrate scientific approaches from public health and urban planning disciplines and look at older adults' walking behaviour from an equality perspective. I use the global positioning system (GPS) technology to measure walking levels, questionnaires to understand older adults' perceptions of their surrounding environments, and walking interviews to identify older adults' needs for walking."

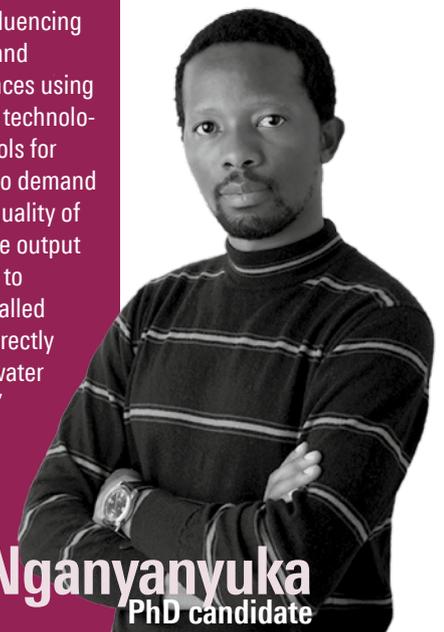
Razieh Zandieh
PhD candidate



Vestine Uwiringiyimana
PhD candidate

"I am working on elucidating the effect of dietary zinc intake and mycotoxins exposure on chronic malnutrition of children in both the rural and urban areas in Rwanda. I will also study the overall effect of selected environmental factors such as slope, soil, temperature, rainfall and humidity on the above two factors, and thereafter map at a national level the communities vulnerable to chronic malnutrition."

"I am exploring the factors influencing citizens' reporting behaviour and willingness to register grievances using web-based and mobile phone technologies – potentially powerful tools for individuals and small groups to demand accountability regarding the quality of water services in Tanzania. The output of my research will be utilized to develop prototype software (called SEMA) to enable citizens to directly demand accountability from water service providers in Tanzania."



Kapongola Nganyanyuka
PhD candidate

EDUCATION NEWS

Pro-Poor and Gender-Equitable Innovation in Western Africa (PGILWA) – Ile-Ife, Nigeria

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Land is regarded as an asset that, with its associated resources, allows its owners access to loans to build their houses and set up small businesses. However, in many parts of the world, especially in developing countries, land is a scarce resource that is governed by a wide range of rights and responsibilities. In these countries, not everyone's right to land – particularly that of the poor and women – is secured. Compared with men, women often face discrimination in formal, informal and customary systems of land tenure.

Registration of women on land certificates is still a problem, despite improved recognition of women's right. In many parts of Africa, investment in putting in place a sustainable land administration system is low, as most governments provide little or no information on lands. As part of the growing efforts to develop methodologies for pro-poor land policies and to understand and address how they may impact men and women differently, the refresher course Pro-Poor and Gender-Equality Innovation in West Africa (PGILWA) was organized by ITC-UT in conjunction with the Regional Centre for Aerospace Surveys (RECTAS), Obafemi Awolowo University, Ile-Ife, Nigeria, from 16 to 27 March 2015. This course, conducted by Jaap Zevenbergen, Liza Groenendijk and Walter de Vries from ITC and Adewale Akingbade, the executive director of RECTAS, brought together 20 NFP alumni from ITC and IHS who were nationals of Ethiopia, Ghana, Kenya, Namibia and Nigeria to examine and contribute to solving key issues in land administration, dealing with modernization, good governance, gender equality and poverty alleviation.



Views from ITC, Netherlands, during some sessions of the distance course

Originally planned for September 2014 but postponed because of the Ebola crisis, the training was eventually conducted in March 2015. A combination of methods was used for the course: delivering part as a distance course and part *in situ* at RECTAS, Ile-Ife, because some foreign countries had placed an embargo on travel to Nigeria because of the uncertainties associated with Nigeria's presidential election which was also scheduled for March 2015.

The programme therefore consisted of face-to-face lectures; e-learning in terms of broadcast of recorded video lectures; and lectures given directly in real time using Skype (internet connection), with on-the-spot question-and-answer interaction with resource persons in their offices at ITC-UT and the participant group at RECTAS Ile-Ife. The context of the refresher course was set with the introduction of participants to issues considered to

be characteristic drivers and indicators of “modernization” in land administration. This introduction involved a brief explanation and elaborate group assignments and interactions to brainstorm ideas to reflect the participants’ understanding of the following elements of modernization in land administration:

- socio-political (e.g. role of government)
- socio-organizational (e.g. views on control, management, coordination, steering, governance, and labour relations)
- socio-technical (e.g. technological changes and persuasiveness of technology in society)
- socio-cultural (e.g. role of civil society and gender issues).

Guidelines for all group exercises and assignments were downloaded and participant solutions to assignments were uploaded onto the University of Twente online blackboard tool made accessible to participants during the training. The theme woven into the entire fabric of the course was the development, identification and application of effective innovative tools in land administration as a means of promoting good land governance, gender equality and poverty alleviation with a gender-quality focus.

The techniques and methodology utilized in the course included expositions on emerging innovations in land titling and registration, FAO guidelines, principles of point cadastre, the usage of mobile mapping, VGI, and crowd sourcing for land administration as modernization in technical surveys, mapping and data collection. Research tools in land administration (participatory approaches, case study methodology, Q methodology and qualitative approaches) were also discussed. Land administration is seen as a way of efficiently managing land and information about land. It involves tenure, use and value as well as legal, organizational and technical (IT) aspects.

The participants’ individual presentations, when they shared personal experiences in land administration, land tenure and land governance projects in their respective countries through PowerPoint presentations and real-time Skype transmission and interaction, proved a major high point. These showed that many conventional government land administration systems do not provide security of tenure to the people, especially the poor and the disadvantaged women. Many of these do not have legal documents for the land they occupy or use, while many others in this category occupy locations that cannot be formally documented within the country’s existing land tenure systems. Although existing land title registration arrangements are being implemented in all the countries represented by the participants,

these arrangements are riddled with poor guarantees concerning security of tenure for the registered land interest. Consequently, the security of land tenure decreases with increasing poverty level, whereby it is perceived that the rich have greater security of tenure than the poor within the same registration system. Different types of land tenure were identified under the existing arrangements, including the statutory or formal system, the customary system, and a mixture of the two in some countries such as Nigeria. On the issue of land registration, many do not believe that acquiring a land title necessarily leads to poverty alleviation. The over-centralization of land management and administration and the lack of both appropriate resource use and the political will to tackle problems emerging from the implementation of land tenure registration are found in most cases. Furthermore, because public information on land title registration is scarce and updating activities to support land registration information are inadequate in many countries, these systems have neither fulfilled technical, functional or customer requirements nor adapted to timely advancements through innovation. However, the story was not entirely bleak, as certain countries provided information on some innovative approaches and the steps being taken to improve land tenure registration in developing countries. One such example was the Ondo State Systematic Land Titling Registration (SLTR) project.

The participants were taken on a study tour to the SLTR project of the Presidential Technical Committee on Land Reform (PTCLR) in Akure, Ondo State. SLTR is defined as the process whereby designated contiguous areas of land spanning several land parcels, which could be either under public/private ownership or not yet allocated, are surveyed using high-precision handheld GPS in one operation by officers especially appointed for the purpose. In contrast to the sporadic methods operating in many parts of the country, SLTR is planned and implemented in a systematic manner, with the aim of investigating and adjudicating land rights for all land in declared SLTR areas. Among the features that qualify SLTR as an innovative land registration project are involvement of the community through intensive public awareness at town hall participatory meetings, communal verification of ownership claims, and public viewing of all registered titles under this arrangement to ensure an inclusive participation of all stakeholders (i.e. enabling the poor to have access to the same detailed information at the same time as all other interested parties), thus utilizing a pro-poor approach to safeguard the interests of vulnerable persons within the community who may have been marginalized under the old arrangement. The Ondo State STLR is making



A training session with recorded video



A session with in situ resource person

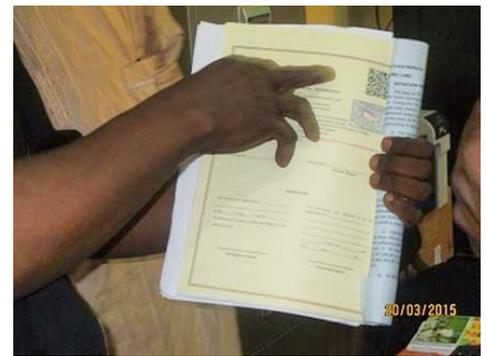
use of the Solutions for Open Land Administration (SOLA) software, which was initiated by the land tenure team of the Food and Agriculture Organization of the United Nations (FAO) as a low-cost measure to benefit security of tenure for the poor. SOLA aims to make computerized cadastre and registration systems more affordable and more sustainable in developing countries. Over 16,000 parcels of land have so far been captured in the three pilot local government areas with a relatively high rate of success. However, the major challenges to the programme include cynicism, disapproval, issue of absentee claimants, conflicts of interest, communication gaps, and continuity in the case of changes in administration.

To enable the participants to further enjoy the ambience of the many serene and beautiful environments within Nigeria, they were taken on an excursion to the Ikogosi Warm Spring in Ekiti State, which neighbours Osun State where Ile-Ife is located. The participants were captivated by the wonder of nature: a warm spring and a cool spring flow in the same stream channel side by side, unseparated by any physical feature but retaining their different temperatures for the entire length of the stream. It was a fascinating experience.

In reaching a consensus from the learning and diverse experiences shared by both participants and resource persons, it could not be denied that land administration in many countries is extremely complex, lacks transparency, and is riddled with various forms of corruption. Therefore, it was reiterated that ensuring secure land tenure and property rights is fundamental for accessing a wide range of developmental benefits, including housing, human rights, livelihood, economic property and sustainable urban and rural development. Furthermore, the course equipped participants with the techniques and innovative tools necessary to modernize, improve and simplify land administrative systems, as well as make the process more transparent. Other course highlights presented avenues for initiating and encouraging responsive land governance through coherent interaction between land policy/land governance reform and land law reform, for example by promoting coherence between relevant conventions and land laws. To further ensure that land rights and the rights of local communities are



Some SLTR products from implemented operations



Participants at the Ikogosi Warm Spring savouring the wonders of the warm and cold springs



safeguarded, countries were encouraged to adapt legislation and regulations such as state land inventory, legal recognition of customary rights, lease rights and land registration. Emphasis was placed on promoting e-governance in order to ensure transparency, equality, and good governance in land administration in Africa, because raising awareness/sensitization was identified as a functional tool that will play a key role in stimulating modernization. The participants were further familiarized with a wide range of modernized electronic tools for sharing information among themselves as professionals and for promoting knowledge and information sharing on land administration for its equitable distribution among the target population, since some of these internet tools could be accessible in many areas of the developing economies.

At the end of the training, participants were asked to evaluate the refresher course and provide lists of comments and recommendations. They were also requested to complete an online questionnaire to assist NUFFIC in improving its service delivery in similar programmes. The participants expressed their appreciation to ITC, RECTAS, the UT and NUFFIC for the organization of the refresher course and hoped for further training in other parts of Africa.

A special dinner organized in honour of the participants brought the course officially to a close. Among the specially invited guests on this occasion were the Nigerian second representative on the RECTAS council and Professor O. Kufoniyi, the former executive director of RECTAS (also an ITC alumnus). The event featured words of appreciation for the good conduct of the participants during the course and words of encouragement to reassure the participants that they could still make an impact within the various challenging land administration situations in their respective countries. The participants also appreciated the organizers and the resource persons that participated in the course. The night was very relaxed, with much food, drink, dancing and merrymaking. ■



RESEARCH NEWS

Find Suitable Nature for Tourism with Flickr!

ITC Scientists Determine Potential of African Protected Areas with Photo-Sharing Platform

Kim Hovestad

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There is now a scientific method to determine which nature in Africa is best suited for tourism. A scientist from the ITC faculty of the University of Twente, together with international colleagues, has investigated how often African animals appear on the photo-sharing platform Flickr. They used this to determine the popularity of these animals and then examined in which areas they are found. In this way, they identified which protected areas have the greatest potential for nature tourism. They also looked at the protected status of these areas and management plans for conservation. It appears from the research that many protected areas are very suitable for nature tourism, without clashing with existing plans for nature conservation. The results of their research were recently published in PLOS ONE.

Popular Animals

One of the ITC scientists involved in the research was Dr Louise Willemen: "We assume that the popularity of animals is a good indicator for the attractiveness of a region to tourists. Photos of animals posted online are a good way of measuring nature tourism because they show which animals people like to photograph, which animals are visible at the right moments, and which animals are recognizable. We know that these three factors play an important role in nature tourism." Lions, elephants and leopards appear to be the three most popular animals for tourists.

Popular Nature Reserves in Africa

The list compiled by the researchers is accessible for everyone. Here (http://andrewcottam.github.io/tourism_potential_africa/) you'll find a map and can select, for example, the top 10 or top 20 protected areas in Africa and see which animals are found there – useful when preparing for your holiday to Africa. You can also see in the table how many photos from that area are posted on Flickr. Samburu National Reserve in the middle of Kenya has the most popular animals. Willemen: "The list is a good indication, but factors such as accessibility, facilities and safety determine whether an area is really suitable."

Safari for Protected Animal Species

In Africa, wildlife-watching is the most popular activity for nature tourists. Nature tourism is a major source of income to finance conservation. Willemen: "The problem is that the animals which are most popular with tourists generally do not need the most urgent protection. It is the endangered species that need the most money to protect them. A system is needed whereby the money earned by the parks with many commonly popular animals is shared with the parks with lesser-known endangered species." ■

ABOUT DR LOUISE WILLEMEN

Louise Willemen works for the Natural Resources department. She performs research into the value of nature for humans: How does nature contribute to our wellbeing?

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ANNOUNCEMENTS

Renewed Accreditation for Master Programme Geo-information Science and Earth Observation

The academic MSc degree programme Geo-information Science and Earth Observation has received renewed accreditation by NVAO, the Accreditation Organization of the Netherlands and Flanders. The MSc study programme of our faculty has also been awarded the distinctive feature “internationalization”.

The aims of NVAO are to assess and assure the quality of Dutch and Flemish higher education, thus ensuring that the level and quality of education is up to standard and that this is recognizable by and transparent to society.

All Tracks

The accreditation is an acknowledgement of all MSc tracks. Moreover, the nine joint education programmes (JEPs) that we maintain with Chang An, Gadjah Mada, IIRS, Ghana, CNU, BNU

and TU Bandung, as well as the iGEON course with Lund, and the GEM course with Lund, Southampton, Reykjavik and Warsaw, were also accredited.

Excited

ITC is very excited about the result. In particular, the awarding of the distinctive feature “internationalization” marks a special step. ■

Marina van Damme Scholarship for Vietnamese Dang Anh Nguyet

Kim Hovestad

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The board of the Universiteitsfonds Twente has awarded the Marina van Damme Scholarship 2015 to Ms Dang Anh Nguyet. She was chosen from among 20 candidates. Dang Anh was born in Vietnam in 1988. In 2010 she came to study at the ITC faculty; in 2012 she gained her master’s degree in Geo-information Science and Earth Observation. Currently, she is working for the Asian Institute of Technology in Thailand.



Excellent and ambitious

According to the jury’s assessment, Anh fully satisfies the profile of a Van Damme Scholarship winner. In its report, the jury states, “She is excellent in her field of study, ambitious, with a social

objective in mind, and could really use the support. Her excellence is evidenced by, among other things, the various awards she has received during her academic career. Her ambition knows no boundaries. After achieving her bachelor’s degree in

Vietnam, she travelled far from home to study in Twente and then went to work in Thailand. Throughout her career as a researcher, she has focused on the impact of a changing use of land on the ecosystem.

Consider, for example, such issues as erosion, soil degradation, flooding and the preservation of biodiversity, water quality and, in particular, agricultural productivity. She develops models that may provide local governments with the necessary tools to make policy choices with respect to efficient land use. Ultimately, she wants to use her knowledge in the poorest areas of the world, including Vietnam, her home country." ■



Helga Zevenbergen, business woman 2014 of Twente, handed the award to Dang Ahn during the Innovation Lecture

Geospatial Technologies for Sustainable Urban and Rural Development

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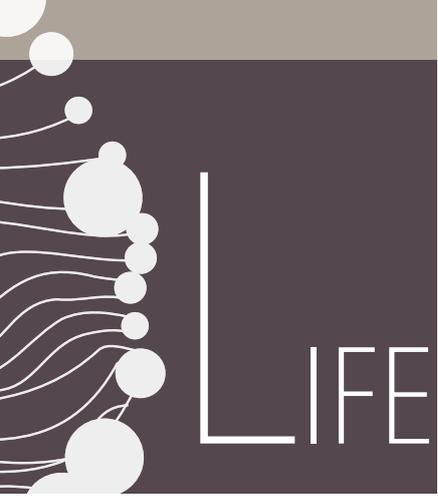
The International Conference GeoTechRwanda 2015 is being organized in Kigali, Rwanda, from 18 to 20 November 2015.

The International Conference on Geospatial Technologies for Sustainable Urban and Rural Development is being jointly organized by the College of Science and Technology of the University of Rwanda, through its research Centre for Geographic Information Systems and Remote Sensing (CGIS) and the Department of Geography, in collaboration with the Faculty Geo-Information Science and Earth Observation (ITC) of the University of Twente (UT), the Netherlands.

The conference will be held in Kigali, Rwanda, from 18 to 20 November 2015. The main objective of this conference is to share knowledge and experiences of cutting-edge research and innovations using geospatial information technologies to address critical issues concerning sustainable urban and rural development at

local and national levels. The conference targets professionals, technologists, planners and managers from institutions of higher education, governmental institutions, NGOs and the private sector who are using or have an interest in geospatial technologies and their use in spatial development issues. ■

For more information about participation and submitting abstracts, we invite you to visit the GeoTechRwanda 2015 conference website: www.geotechrwanda2015.com



LIFE AFTER



My Treasure June

Dang Anh Nguyet

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This has been an unforgettable summer for me – a chance to come back to ITC, the University of Twente, Enschede and the Netherlands. The reason that brought me here is really special. I was very honoured to be the 30th woman to receive the Marina van Damme Award, which is named after Dr Marina van Damme, the first female Doctor in the Netherlands. She dedicated her life to science and to helping young and ambitious females to embark on their professional careers.

This one week in the Netherlands has been full of emotion and memories for me. No words can express the feeling when I first stepped on the platform at Enschede station. It has been three years since the day I left this station. All of the memories rolled back like a slow-motion movie. I took a deep breath of Enschede air and stepped out of the station. I scanned my memory of the Enschede scene and looked to see how it was now. My Enschede is mostly the same: peaceful and gentle. Jorien Terlouw came to pick me up and took me to ITC. After reaching ITC, I walked slowly through the back gate and the garden and entered the ITC restaurant. Here I met my friends and especially my teachers, who I miss most. Memories flooded back and brimmed over. Each corner recalled stories of our tough but happy time with one another at ITC. We kept on talking and nearly forgot the time. My ITC still awakens in me the feeling of a second home.

Especially, I was very happy to have a chance to meet my two beloved supervisors. Hussin is still full of energy and his office looks the same as I remember. My beloved Michael now has a new job – taking care of his two lovely granddaughters. I am very happy to see them still happy and healthy. I wish them all the best. I was also very lucky to have a chance to meet up with my good friends who found love and now have a happy family in Enschede or who continued to do a PhD at ITC. I also met Chi Tho, who was an ITC alumna and helped us, the Vietnamese community, a lot during the time we were living here.

The big day, 2 June, came. The Innovation Lecture at the UT was really professional and inspiring. I was overwhelmed by the new innovations, changes and achievements of my university. I feel very proud to be a part of ITC and the UT. At a special moment, my name was called and the jury handed me the award and

sculpture. It was my first time speaking in front of such a big audience. Once again I would like to send my deepest thanks to Dr Marina van Damme, the juries, ITC, the UT, the Universiteits Fonds, my supervisors and my family. Without them I could not have had the prestigious chance to stand there, receive the award, and experience a new turn in my career.

With the award, I intend to conduct research into the impacts of land use change on ecosystems and human life in Cuu Long River Delta in Vietnam, my home country. Receiving the award is really beyond my expectation and imagination. My intention when sending the proposed research was just to contribute my small part and hope to inform the University about the ongoing activities of alumni around the world. As part of ITC, University of Twente, we always do our best to keep the flag of ITC and the UT flying high. I hope my success can inspire my friends and fellows at ITC to apply for this award in the coming years. ■



Dr Marina van Damme and Dang Anh Nguyet

UNIVERSITY OF GLOBAL PIONEERS.



IN A GLOBALISING WORLD, WHAT BETTER PLACE TO KICK-START YOUR CAREER THAN A UNIVERSITY WHOSE CORE BUSINESS IS TO CROSS BOUNDARIES? OUR VERY REASON FOR EXISTING IS TO ENGAGE IN GROUNDBREAKING RESEARCH, CHART NEW ACADEMIC TERRITORY AND CONSTRUCT MULTI-DISCIPLINARY ANSWERS TO THE CHALLENGES OF TOMORROW. AS A RESEARCH UNIVERSITY WITH A STRONG FOCUS ON THE DEVELOPMENT OF TECHNOLOGY AND ITS IMPACT ON PEOPLE AND SOCIETY, WE ATTRACT AMBITIOUS, ENTERPRISING STUDENTS FROM AROUND THE WORLD. OUR HANDS-ON ATTITUDE, ALONG WITH OUR UNRIVALLED NETWORK OF INTERNATIONAL BUSINESSES AND INSTITUTES, MAKES US EUROPE'S MOST ENTERPRISING UNIVERSITY. AT OUR PARK-LIKE CAMPUS, WE OFFER A COMPREHENSIVE ARRAY OF ENGLISH COURSES IN THE FIELD OF TECHNOLOGY AND BEHAVIOURAL AND SOCIAL SCIENCES. HEADING OUT INTO THE WORLD? START HERE.

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HIGH TECH HUMAN TOUCH

