

Sustainable Urbanism in rural growth regions – A case study in Rwanda

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ABSTRACT: The presented urban development project in the district of Nyanza, Rwanda is an examination of existing dispersed rural settlement patterns, which were studied in the context of providing proposed infrastructures that encourage the continuation of current informal activities taking place, such as local food production and other forms of self-sufficiency and closed-loop production systems. In this regard the study analyzed the potential of the historical grown landscape and other areas like it to “leapfrog” development steps within an urban densification process, using local knowledge and rural techniques to avoid some of the ecological problems caused by conventional development paths followed by industrialized nations while the economic basis of a majority of the population’s livelihood could be maintained. The paper should provide a valuable perspective on the potential contributions of rural populations in Rwanda and elsewhere to the current debates on sustainability and resource conservation.

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1. CONTEXT

1.1 global context

The growth of cities and mega-cities, followed by the emergence of slums with their negative effects on ecology, society, health and infrastructure, is a highly discussed phenomenon, especially in cities in the South and emerging nations - a development caused both by rural poverty and the attraction of booming urban economies. However, worldwide, the rural population also increased from 1.5 billion to around 3 billion in absolute figures, even though the percentage of population has reduced from 80 per cent in 1950 to 50 per cent today. Regarding the worldwide increase in population to nine to ten billion people within the next fifty years, the earth will thus reach its maximum capability regarding its natural resources like soil, water and energy (Ribbeck 2005).

Within a rampant urbanization it is indispensable to think about new sustainable urbanisation strategies also for the rural areas.

1.2 local situation Rwanda

Rwanda, roughly the same size as Hawaii, is not only one of the smallest countries in Africa, but has also the highest population density on the continent, which can roughly be compared with Holland (on average 350-400 inhabitants/ square kilometre). A large part of the population lives on subsistence farming, i.e. the individual supply with food from their own piece of land.

Therefore, dispersed settlements are characteristic for the cultural landscape in large parts of the country. The “land of a thousand hills” with its small-scale agricultural use resembles a large garden with a very special charm. The capital Kigali is supposed to develop into a service and communication location for the whole of central Africa and is one of the “hypergrowth” cities (annual growth rate of approximately nine per cent). However, the rural population will also continue to increase. With a currently predicted population increase of 2,78 per cent (www.indexmundi.com 2007, on average per annum, a density of approximately 1000 inhabitants/ square metre will be reached in 2050, comparable with the current density of Bangladesh. Due to these facts the resources in Rwanda, such as land, water and energy are extremely limited.

Thus the introduced project in Rwanda should show that,

1. it is essential to read and understand the existing settlement structures and elements and to know about the respective background (local context);
2. the existing vernacular architecture and urban structure provide local potential for future densified development, especially in an increasingly globalized world;
3. the interacting effects of existing settlement structure and new technologies of water and energy supply based on regenerative resources play an important role.

Furthermore a general question can be discussed within this theme:

4. Is the pre-modern agricultural society, that still exists in the rural areas of Rwanda and shaped a scattered settlement pattern with a high rate of subsistence farming able to overleap the industrial era and thus the modern city and develop directly into a post-modern service and knowledge-based society with different urban patterns?

1.3 Urbanisation of landscape as opposing model to the traditional city

Considering the global consumption of resources the ecological footprint of Rwanda is still very low, whereas the apparent efficiency of industrial countries results in a large ecological footprint.

Compact city systems are generally considered to be space saving and therefore sustainable even though a majority of raw materials has to be imported and later on exported as waste. Though it is often not considered which territories are required to supply the city e.g. with food and to dispose the waste. In contrast, the rural areas with their scattered settlements could be used for urban concentration and could be valorised on the basis of local closed-loop models for the production of food and the securing and generation of other primary factors such as ground, water and energy.

A study presented by the United Nations particularly shows agriculture as an instrument of a closed-loop economy. Instead of consuming resources and food and leaving them as waste - open loops -, recycling models shall be developed with the aid of agriculture, which reduce the demand in raw materials and waste production - closed loops - (UNDP 1996). The close connection between agriculture and housing additionally provides space for concepts of living that are based on self-production and informal economic concepts. These are qualities outside the tangible system of values that will also gain importance again for the western world dominated by the division of labour and economic growth.

Furthermore it is a likely conception that by use of innovative communication technologies and an area-wide upgrading of ITC-infrastructure the so far common principles of urbanisation will take a course totally different from the industrial nations' history and that a new type of settlement will be created. This is particularly the case in a process in which cities are increasingly disintegrating and rural areas are becoming more and more urban.

1.4 Referee to similar approaches

The project is closely linked to the cluster of research *urban land scape* within the department of Architectural Design & Urban and Landscape Planning of Technische Universität München, which deals with the study and reassessment of dispersed structures as well as with current issues of different aspects of city landscapes.

Since the contrast between city and countryside is disappearing all over the world, formerly rural areas are developing into a new type of settlement, the "landscape city". This new type cannot be described in conventional terms of landscape, as these clearly depict an antithesis to the term city.

"City-landscape and landscape-city are two different perspectives of *urban land scape*, depending on whether it is viewed according to the disappearance of the traditional city shape or to the increasing urbanisation of the traditional cultivated landscapes" (urbanlandscape 2010).

2. RESEARCH PROJECT "URBAN AND SETTLEMENT PLANNING NYANZA – RWANDA"

Confronting the challenges of rampant urbanization demands integrated, multidisciplinary approaches, and new thinking.....

It may seem utopian to promote these innovations in the emerging and developing world, many of whose inhabitants can barely afford a roof over their heads. But those countries have already shown a gift for technological fast-forwarding, for example, by leapfrogging the need for landline infrastructure to embrace mobile phones. And many poorer countries have a rich tradition of adapting buildings to local practices, environments and climates - a home-grown approach to integrated designs that has been all but lost in the West. They now have an opportunity to combine these traditional approaches with modern technologies. (Davis 2008)

This quotation by Mike Davis describes best the contents as well as the methodic proceedings which are relevant in the described research project.

2.1 University-cooperation and interdisciplinarity

A conceptual master plan for the district Nyanza by a team from Technische Universität München (TUM), Kigali Institute of Science and Technology (KIST) and the local community was a first applied research project within a university cooperation between TUM and KIST, that was integrated in research as well as in science. In order to create a holistic and forward-looking approach, it has been a matter of concern to work on this project in an interdisciplinary team to account the interacting effects of settlement and landscape development, land-management and infrastructure supply. Since January 2009, KIST has set up the first department for architecture and urbanism in the country to submit the academic education of local experts in the long run. The implementation of the project in the education process and the collaboration with local partners in the community should guarantee a sustainable realization.

2.2 region characteristics

The district of Nyanza is located approx. 70 km south of Kigali. Due to an administrative reform Nyanza has been the capital of the new South Province since 2006. Nyanza used to be the King's residence, now an art and history museum is situated there. Due to its growth of importance the municipality is faced with numerous tasks in urban planning and needs new space for administration, commerce and housing. The landscape around Nyanza is defined by rolling gentle hills and wide, plateau-like elevations. While the hill ridges are populated, the swampy, very fertile valleys are mostly free from buildings and are cultivated co-operatively. House, farmyard and plot form the basic unit for various settlement models whose structures range from the prevalent dispersed settlements, one-street villages and villages built around a common to agglomerations with commercial use and the village centre with a market area.

2.3 vernacular principles

Anonymous construction in Rwanda has adjusted to the local conditions, particularly the climate, and the locally provided resources over the past centuries.

Clay construction already represents a large part of housing construction, particularly among the poor population. The houses are either constructed as solid structures with air-dried clay bricks or as frame structures of wood or bamboo with a clay infill. This is owed to the scarcity of other building materials. Clay construction is an example for an existing local circulation model, since material generation, processing and recycling can be performed on site, the material is cheap, easy to process and its production requires little energy. Thus, it also contributes to lowering the primary energy demand. Unfortunately, the material is only little appreciated, since clay is only used by the poor population.

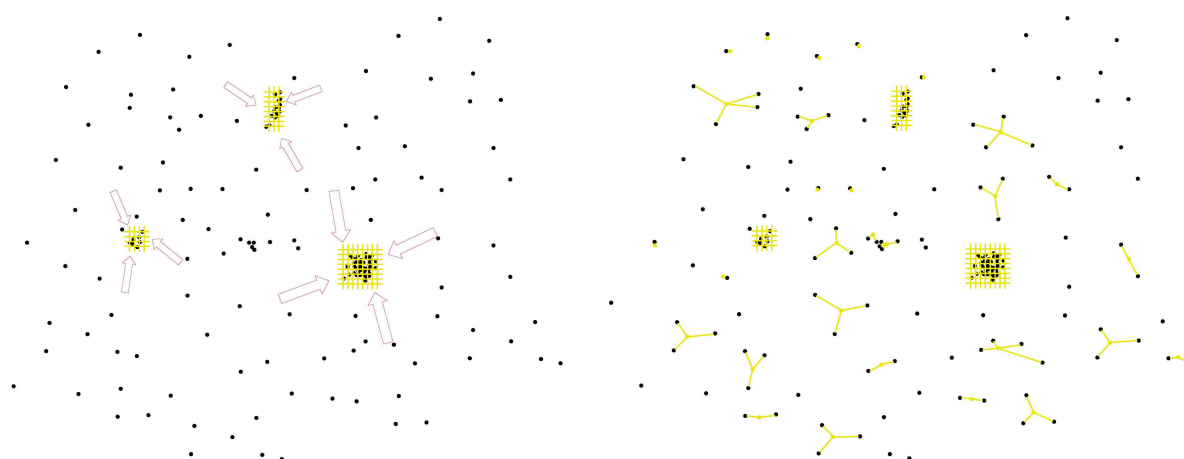
Furthermore for a long time clay was not accepted as a building material in Rwanda; therefore most of the clay houses were considered to be illegally built. In a pilot project in 2006, the German Development Service (DED) cooperated with the local authorities in Kigali to prove that clay is a durable material if used for construction in the right way. Only after that clay construction officially was accepted and long-term strategies could be developed for low cost housing construction. (Ilberg 2006)

It is one aim of the project to improve the image of the construction material through architectural projects in the sector of public and private buildings and to develop various strategies for low cost housing built in clay. In a similar way, local building material production and the use of low-cost materials with labour-intensive production can strengthen the local economy and contribute to generating income. Furthermore building culture and local traditions of construction will be enhanced.

2.4 infrastructural concepts for water and energy as spatial elements

In principle, there is no shortage of water in the district Nyanza, as the region is rich in wellsprings and rainfall. However, access to clean drinking water must be improved as well as a plan for waste water disposal will be indispensable to protect water reservoirs in the future.

Rwanda's average energy consumption per capita rates among the lowest in the world. However, the few forests that are still left have been reduced extremely as wood is the main source of energy for cooking.



Source: Lunau/ Eibel 2010

Fig 1: The graphic shows that different infrastructural concepts – centrally or decentrally organized – can influence the further development of settlements.

- The implementation of centrally organized grids for electricity, gas and water benefits areas of higher agglomeration like cities or towns. This implies that migration of people from the rural to the urban areas increases, resulting in the emergence of slums.

- Decentral systems allow an urbanisation of existing settlement structures, which will, depending on the chosen service system, cause new patterns of urbanisation.
- Intelligent synergies of high-tech and low-tech show new possibilities for infrastructure provision independent from fossil fuels and at the same time achieve economic independence and self-reliance in order to create new jobs.
- It is quite possible that development steps completed in industrialized nations can be left out in emerging countries thanks to technological innovation (leapfrogging).

Thus, the “ecological footprint” of these countries can remain small in the future and give an example for industrial nations.

2.5 nyanza future strategies and spatial concepts

In the district of Nyanza we did focus on three exemplified areas containing different spheres of activity. On the one hand there is a rural engraved area without any connection to an infrastructure (Rwabicuma). On the other hand the inner-city condition was examined (towncentre Nyanza), which largely is equipped with a central water and energy supply. As third sphere an area was analyzed where the connection to the traffic infrastructure is almost optimal, however energy and water supply is still missing (Mukingo).

‘rural’ – Rwabicuma



Fig 2: Rwabicuma

The focused area is situated in the west of Nyanza centre and has a comparatively low density with many single farmsteads, smaller house groups (hamlets with 4-5 houses) and three denser villages. The area is poor in agricultural production and neither has access to traffic infrastructure nor access to central water and energy supply. The administrative structure, which splits the district into 10 sectors, again sub-divided into 5-6 cells, supports a decentralised distribution of daily needs. Near to the relevant administrative buildings on cell or sector level, there are – and also shall be in the future - different public functions, like smaller markets, health centres, primary schools, kindergardens. It is an urbanistic chance to form a spatial-architectural concept for these sub-centres.

The landscape structure represents a mosaic of differentiated, multifunctional use, adapted to topographic and site differences. Highly diverse parts of the landscape – with respect to species diversity as well as to structural and ecosystem diversity – can regularly be found on the slopes of the hills, especially on the lower slopes. More extended areas of forests or woodland are oftenly situated on the hilltops on plateaus.

Landscape protection zones

Wetlands in valleys are able to prevent erosion and flooding and are important areas for assuring water quality. Hence, these wetlands should be used for a highly diverse agricultural production in some areas, and they should be restored in other areas in order to improve their very important ecosystem services (carbon sinks). Ecological

buffer zones in the riparian zone along the streams and brooks as well as reforestation zones will be defined and realized. The visual orientation between settlement and landscape will be kept by spatial interruptions within the populated areas— especially on the anticlines – which provide visual axes towards the landscape.

Infrastructure

Decentralised models (with local networks) for water and energy supply will be provided in the rural areas, which are based on commonly used rainwater collection in cisterns and biogas. Construction manuals have been compiled with simple and pictorial guidance to build a cistern, to handle aquifer systems from roofs to a shared cistern i.e. in the center of a settlement cluster. Great importance was paid to the local accessibility of cheap available materials such as bamboo and quarry stone.

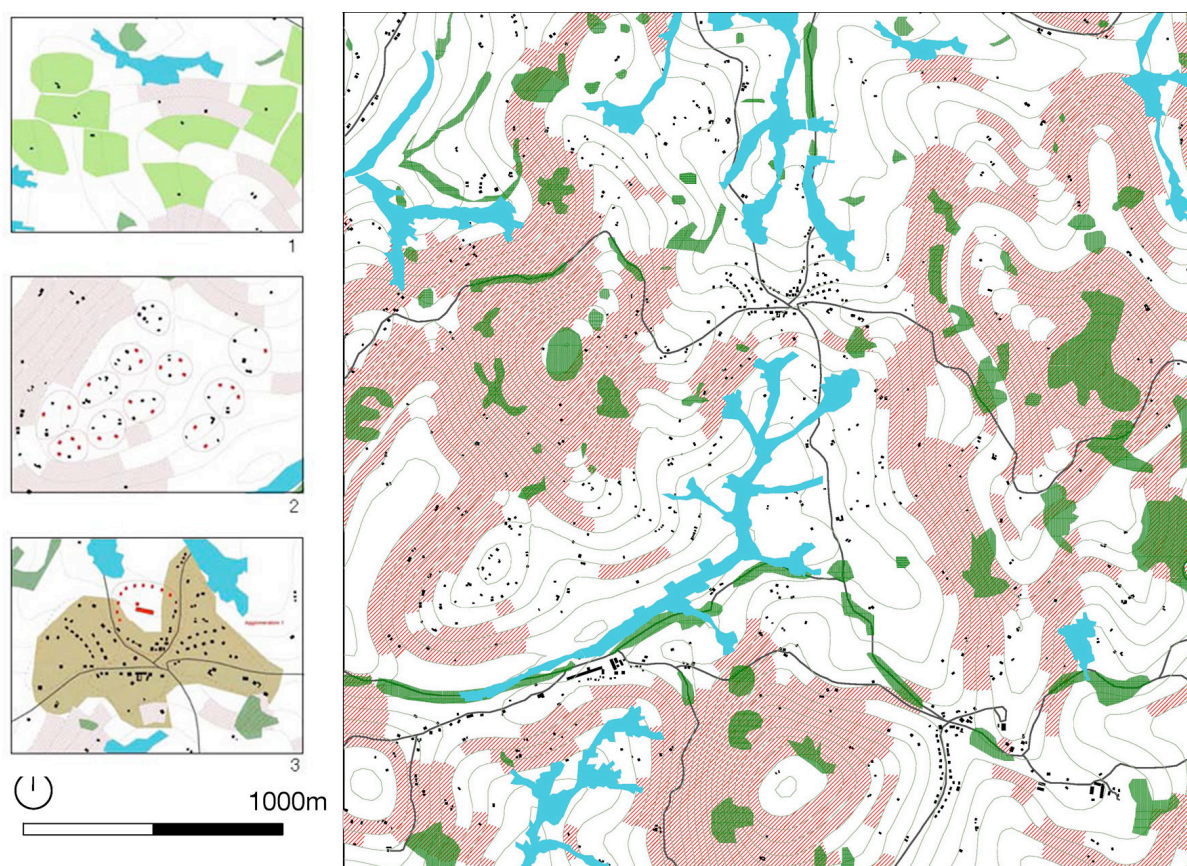
For the placing of decentral water spots like wells and water kiosks minimal demands on accessibility are determined. The distance to the next water access should not exceed 200 metres in urban areas and 500 metres in rural areas.

By example of biogas production (from dejection and biomass) for cooking and lighting it was shown that the existing settlement structure demands different system sizes, thus three different spatial densification strategies are defined.

1_The existing villages will be densified and a biogas plant on community level will be built, using the waste and dejection of 30 households as well as dung of a cooperative cow barn.

2_Disperse rural areas with a certain density will be concentrated in a way that five to six households share one digester.

3_In rural areas with difficult topography and poor conditions for infrastructure no further densification will take place, here each household is promoted to get one biogas plant, that will be fed by the waste of five persons in addition with plant waste or dung of one cow. An agricultural parcel of at least 1.2 ha is needed to get the required plant waste. In consideration of the expected population growth the more realistic alternative for self-sufficient single-farms is to feed the plant with dung in combination with the “one cow per family” programme.



Source: Lunau/ Eibel 2010

Fig 3: different densification clusters with biogas

‘urban’ - towncentre Nyanza

The centre of Nyanza should develop to an urban centre of an important, identity creating, secondary city in the south of the country to reduce the urbanisation pressure on Kigali.

Currently dense areas can be found around the market area and extend to the neighbouring hills. A linear densification also occurs along the regional highway from North to South. The hills are usually populated and the hilltops are mostly occupied by greater building complexes, which appear as “landmarks” while even here the

valleys remain free of buildings. Also rural living areas with low density and a wide-spread settlement structure do exist near the centre.

There is a certain concentration of different functions in the town centre, such as the regional market, trading shops, hospital, secondary schools, district administration and the museums. Functions of daily needs and local administration buildings have a decentralized distribution. Because of good accessibility of these public services the centre is still pedestrian orientated.



Fig 4: towncentre Nyanza

The further settlement development will be effected by the following principles:

The topography will be the backbone for an distinctive spatial pattern of areas with a dense building structure and public spaces on the hilltops, residential areas with medium density on the slopes and more rurally influenced areas with a connection of living and agriculture on the lower slopes. The concept includes a specification of areas for administration, commerce, retail, industry as well as residential use and mixed used areas. The special character that the hilltops are usually occupied by public buildings will be continued and this identity will be strengthened by recommendations for positioning of further public buildings. Areas that have difficult topography such as precipices and regions that do not offer a good infrastructure will not have a high density of settlement in the future. For the identity of Nyanza and for the generation of job opportunities the museums play an important role. Further functions and buildings will promote a sustainable development for tourism in connection with the planned Olympic City.

The already existing central energy and water supply will be extended in relatively conventional means and completed with a biological wastewater treatment in a central sewage plant. The planning requirement was to adjust the site of the plant and the grid of the pipes to the topography in order to minimize the need of pumps and thus avoid energy consumption. The remaining biosolids/ sewage sludge can be used as fertilizer or for power generation.

Based on the extended central infrastructure net new settlement zones with high and medium density can be connected and existing settlements will be upgraded and densified.

‘immidugudu’ – Mukingo

The third focused area in Mukingo is situated in the north of the centre near the regional highway from Kigali to Butare and formulates the entrance area to Nyanza district as well as the sub centre on sector level. Close to the main road into the area Mukingo two street villages with different mixed used functions, the sector office, the primary school and a small market square are located and formulate a small settlement concentration. A second settlement of rather high density that has development potential, is located north west of the clinic Gatagara,

which is also part of the focused area. There does exist a central infrastructure net for energy and in parts for water along the highway and for provision of the clinic. Nonetheless, a bigger part of the households is not connected. Further densification and upgrading of the existing settlement concentration as well as the construction of a new imidugudu with 100 units should on the one hand formulate a vivid sub centre and an adequate entrance area to Nyanza district. Thereby, on the other hand, the extension of the existing infrastructure net could be profitable in near future.



Fig 5: Mukingo

Those different spheres of activities are transferable to other settlements in the region for the most part.

2.6 network city as vision for Nyanza

Based on the endogenous values and the character of the traditional dispersed settlement, a new appearance for the urban cultural landscape – a landscape-city – could emerge. It would be characterized by a polycentric urban structure with different centres and sub-centres, that are linked with each other (network city) and by a small-scale pattern of agricultural and settlement areas due to the topography.

There would be centralised and decentralised systems for infrastructure provision, which are based on regenerative energies and resources. Infrastructure and settlement systems are developed as transformable structures that could be modified step-by-step to more high-tech technologies.

Topics such as ecological farming, organic food, finishing and direct marketing will contribute to strengthening the regional economy and to creating local value chains and make the region mostly self-sufficient, which is gaining importance worldwide.

One pressure which prevents this approach of being followed is a government programme to centralize rural settlement structures. But in contrast to the traditional structures, current concentrated settlement developments (imidigudu) show already that the sensitive system of ecological aspects, the differentiated transition from public areas to private areas as well as the appreciation of the own domestic culture are in danger of being lost. Subsistence farming and the small-scale cultivation of land is deeply rooted in the country's culture, and the topography makes large-scale, industrially characterised agriculture difficult. As well as most of the population's livelihood would be destroyed if they don't have their own land to grow food.

Besides the realization of long scheduled projects such as urban developments often fail because of instability of human resources in the community administrations. The implementation of the project in the education process should avoid this and at the same time the ideas will be spread with a multiplier effect.

This new urbanisation approach is innovative regarding the conservation of resources and is able to cope with the forecast increase in population also expected for rural areas. In this context, architecture and building culture can contribute particularly to strengthening regional identity and are the basis for development.

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