



Economic development in Accra, Ghana

Transforming Accra towards a Sustainable Future: Comprehensive Land Use Planning and the Greater Accra Urban Simulation System (GAUSS)

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The urbanization of Sub-Saharan Africa is occurring more rapidly than in any other region in the world, at a historically unprecedented absolute rate of increase, within an institutional framework desperately lacking in resources. In step with its Sub-Saharan location, Ghana is experiencing unprecedented urbanization with currently 50% of its 23 million people living in urban areas; that share is expected to become 65% by 2030. The lion's share of this growth is taking place in the administrative and commercial center, Accra, which has a population of more than three million people. It is exhibiting a growth rate in excess of 4% per year and is expected to double its population within 16 years.

While Accra has often been considered the proud “superstar” of West Africa with its foundations of infrastructure development beginning with Dr. Kwame Nkrumah, it is an illusion to view the capital city without considering that most service provision levels are failing when compared to the standards of developed nations. Inadequate financing and poor management coupled with rapid growth have led to: water supply coverage declining from 85% in 1990 to 60% in 2004; solid waste collection coverage of only 70%, even though the expenditure is an enormous part of most local government budgets; and unregulated septic collection and disposal by hundreds of vacuum trucks dumping waste on a daily basis directly into the Gulf of Guinea at Korle Gonno. The transportation network is consistently failing and is considered amongst the most dangerous in the world, the

electricity sector is strained, threatening to reduce GDP by as much as 0.9 percent per year, and public health, education and safety all require significant attention. Weak local governments throughout Accra have met evolving demands for public services with ad-hoc assistance arrangements rather than as part of a consistent and targeted capital improvement plan. These District Assemblies lack basic taxing authority, as evidenced by their inability to generate revenue from property taxes in Osu where real estate values have increased to the point where they are commensurable to some European cities. The World Bank has estimated Accra's capital expenditures at approximately \$2.7 USD per capita as compared to an estimated need of \$80 USD per capita. The effect of inadequate public service provisions is an environment which implicitly promotes urban poverty rather

than poverty reduction. Provisions for public transportation, water and sewer, stormwater, electricity, health, education and safety services are an integral part of the environment needed in Accra and the cities of Ghana to achieve the primary objective of the Growth and Poverty Reduction Strategy and Millennium Development Goal, to achieve middle-income status.

While the problems faced by local and regional governments throughout Greater Accra are daunting, developing and maintaining a spatial decision support system to assist these governments is equally intimidating. One major issue facing urban modelers as we forecast land use change is how much data do we need? Robert Solow once stated that simplifying assumptions is the essence of model-building, while the philosopher of science Russell Hanson noted that if one progressed from a five-inch balsa wood model of a Spitfire airplane to a 15-inch model without moving parts, to a half-scale model, to a full-size entirely accurate one, you would not end up with a model of a Spitfire but with a Spitfire itself. Even Lewis Carroll remarked that a map on the scale of one-to-one would serve no purpose. So how much data is needed to create this spatio-temporal map and where do we draw the boundary of simplicity for this increasingly complex and uncertain West African city? How can we incorporate three-dimensional satellite imagery and the complete inventory of building envelope signatures which can be used to derive existing land uses for millions of structures? Or, what use is there in recording the origins and destinations of every individual transportation decision made throughout Accra on a daily basis? And this only concerns macroperspective observations, for without detailed surveys of households, businesses and institutions, this externally captured data lacks the detail needed to describe the microenvironment and its disaggregate, individual agents. The science of the city has come a long way from Lowry's gravity models, Leontieff's work on spatial input-output models, and the "7 Deadly Sins" described by Doug Lee in his 1973 *Journal of the American Planning Association* (JAPA) article, *Requiem for Large-Scale Models*. Modern geographic information systems, such as ArcGIS or QGIS provide a powerful medium for integrating static and dynamic physical and human geographic information with: statistical modeling platforms such as R or Stata; database systems such as MySQL or PostgreSQL; and extensible programming languages such as Python or Java for specification, parameterization and programming individual

agent behavior and environmental constraints, as well as coupling equally sophisticated transportation models.

But simply accepting that the hyperdynamics of Greater Accra amounts to a complex system, arguably rivaling the microcosmos of the human body or the macrocosmos of the universe is only the beginning. How do we go about obtaining all this data we need and what responsibility do we have, once we have it? In his book *Far-Fetched Facts*, Richard Rottenburg provides a fascinating and thoughtful ethnographic analysis of developmental relations between rich countries in the north and poor countries in the south and Hans-Jörg Rheinberger, author of *Toward a History of Epistemic Things*, elaborated upon this parabola of development aid in terms of the central conflict of interests: the necessity for donor countries to control money flows, and the political goal of self-determination on the part of recipients. The incongruences of these transnational institutions have been illustrated on a pan-African scale by Dambisa Moyo in *Dead Aid* or one only has to cross Zion Street at Korle Lagoon to find a 20 million USD, World Bank funded wastewater treatment facility idly awaiting wastewater to treat. The relevance of this conflict becomes clear when attempting to collect data in Accra, where the concept of the public domain has great strides to make before it becomes a reality. A second and equally important issue is related to statistical disclosure limitations and the right of confidentiality for all human beings, wherever they may reside. The work of Jerry Reiter at Duke



Fishing boats along the shoreline of Accra, Ghana



City sprawl, Accra, Ghana

University and Andrea Alfons at Technische Universität Wien is central to synthetically generating large scale data sets which spatially retain the statistical parameters of original survey samples, while also maintaining the rights of individual privacy.

While urbanization's impact is clear and poverty reduction should be the primary focus, how do we reconcile the need for Greater Accra to be an economic development engine with the equally important concern for environmental degradation resulting from ad hoc, arbitrary and private land use transformations? An additional complication is contextual – the dual title system – where central Accra uses the British system for subdividing and registering property, while the massive urban sprawl resulting from forest and agricultural lands transitioning to low density, single family residential homes, occurs under the authority of traditional rulers such as the Asante or Fante and their customary land title system. How do we introduce comprehensive planning, zoning and development permitting, within a context that often subjectively favors indigenous institutions and criticizes “foreign” practices without exercising objective judgment? How do we synthesize modern land use planning practices for transforming towards a more sustainable future with the vernacular of indigenous institutions, rooted in hundreds of years of culture and history? The vernacular of each local and regional jurisdictions' approach to governance will always exist, but is it really necessary to “reinvent the wheel?” In some cases the price of modernity may be the need to significantly transform or reinvent the institutions themselves.

Creating and developing the Greater Accra Urban Simulation System (GAUSS) required more than a series of two week visits and a return home expecting to make a meaningful contribution. In order to understand the deeper, often hidden, meaning found alongside the interconnecting pathways of Accra, it was necessary

to become a resident for a lengthy period of time. Modeling the urban dynamics of Accra required more than negotiating with local scientists and engineers to unlock the connections, data and their means for the practical application of advanced theory. Creating GAUSS required a real understanding of the daily risks encountered in millions of people's lives, and the complexity that arises from the billions of interactions for which there will never exist a satellite system or realtime network capable of recording the data necessary to create this one-to-one map of Accra. At some point all of our simulations reach a quantitative limit and it becomes necessary to take a step back, invoke qualitative understanding, and use the same common sense which is most likely akin to the local knowledge found in Cantonments, Agirigano or Kokomlemle in the first place. GAUSS continues to be a journey through an incredibly complex realm lying at the crossroads of the developing and developed world, the public and the private sectors, between academia and professional businesses, and more important than any synthetic dataset, location choice coefficient or scenario run is a personal understanding of the families and individuals living in Accra and the commitment necessary to make a lasting and meaningful contribution towards the transformation of their sustainable future.

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