Low-Cost and Eco-Conscious: Compatibility in Amani Village

1. Introduction

Urbanization is a phenomenon seen across the globe. People in rural areas are rapidly migrating to urban centers in search of jobs and a better life. Kenya is no exception. Over the past four decades, Kenya has seen incredible rates of migration from rural to city. In 1962 only one in twelve Kenyans lived in urban centers. In 2005 this grew to one in five (20.4%) and is projected to rise to 60% by 2030. This rapid migration has created massive informal settlements with substandard conditions.

This paper is an analysis of Amani Village - a low-cost, eco-conscious pilot development in Ukunda, Kenya. The development began in April 2011 and is scheduled for completion in February 2012. The project is being funded by the Asante Foundation, dedicated to alleviating poverty in Kenya through enterprise. Amani Village consists of 59 units: 32 single bedroom homes, 10 two bedroom homes, 5 three bedroom homes, 6 commercial spaces, and a nursery school. Each home will have access to clean water, electricity, and clean ownership of the property. The development will provide affordable, safe, and sanitary housing to an estimated 285 people.

Figure 1: Location of site. *Source: Google maps*

With the success of the pilot project, the development model will be replicated in various locations African coastal towns. The Asante Foundation hopes to create a viable low-cost housing business building 2,500 homes in the next 5 years.

The paper has two main sections, namely the low-cost financial, and analysis of the eco-conscious aspects of Amani Village.

2. Low-Cost: Financial Analysis

Demand for Low-Cost Housing

The Coast Province of Kenya is home to 2,487,000 inhabitants (1999 census). The coast of Kenya is a beautiful vacation spot for tourists around the world. With white sandy beaches, a tropical climate, and close proximity to game parks, the region is packed with tourist agencies, hotels, and resorts. With the expanding tourist sector and the largest port in East Africa (Mombasa), Coast Province is an attractive place for business. Anxious Kenyans are migrating to the coast in search of jobs.

Hotels, resorts, and European vacation homes are popping up all over the place, but nobody is building homes for the poor. The profits for high end developments are huge, so it's no wonder that construction companies are building resorts. The low-end market has been entirely ignored. This has created a massive untapped market for high volume, low-cost housing.

The vast majority of Kenyans on the coast rent. They live in crowded, unsanitary, poorly built shanties. Rental amounts can be as low as 9 USD per month with 120 USD on the higher side. While most people would jump at the opportunity to build equity in a home of their own, the opportunity for such an investment is simply out of reach.

The unaffordable cost of housing arises from high priced construction materials, non-existent infrastructure, and governmental bureaucracy and corruption. The only way to sustainably bring these costs down to a level that is affordable for the bottom of the pyramid is to build developments that are big enough to amortize the large upfront costs over multiple beneficiaries, but small enough not to attract unwanted attention from some corrupt government officials.

Land and Infrastructure

The process of buying land in Kenya is extremely bureaucratic and tedious. For the average Kenyan it is simply too difficult a task. Dozens of documents are required by different government agencies spread out over the district. The transportation costs alone are too much to bear for the bottom of the pyramid customer. On top of the official fees for each required document there are hidden costs of bribery and "grease money" demanded by greedy officials. For an uneducated low-income person, these hurdles are simply too high to clear.

The only realistic solution to this problem, without a complete overhaul of the Department of Lands, is to go through the arduous process and amortize the costs and time over a large number of homes.

After several months of effort the Asante Foundation has secured a three-acre parcel of land for the Amani Village development. The plot was selected based on price and its proximity to the highway (1 km), public schools (1.5 km), and Coast Coconut Farms (a coconut oil factory under Asante Foundation). The land was purchased for 4,705 USD per acre. The property is far

enough away from prime real estate to be affordable, but close enough to jobs and markets to be reasonable for its residents.

The lack of adequate infrastructure is a problem around the developing world. Governments simply don't have enough money or resources to keep up with the demand for infrastructure services like electricity, sewage, and clean water. For a single dwelling home the costs of building your own infrastructure are simply out of the question. A simple connection to the electric grid can cost a Kenyan anywhere from 425 to 56,000 USD depending on their location and who they talk to at Kenya Power and Lighting Company, a government owned monopoly.

The cost of drilling a well, building a water tower, plumbing, and a proper sewage disposal system is too much for a single home but, is reasonable when amortized across 59 units. The budgeted expenses for infrastructure are 70,600 USD. The intended infrastructure will include drinkable running water, flushing toilets with proper disposal of waste, showers, and solar electricity in each home. The chart below shows the amortization of land and infrastructure costs across the residential units.

Amortized Costs of Infrastructure and Land			
Description	Sqft	Cost of Infrastructure	Cost of Land
1 Bedroom A	277	1,201	160
1 Bedroom B	368	1,598	213
2 Bedroom	550	2,388	318
3 Bedroom	924	4,012	535

Table 1: Amortized Costs of Infrastructure and Land. Source: Authors

Building Materials

Most of the discussions around housing the BoP focus on new innovative building technologies, materials, and designs. The most significant costs are actually infrastructure, property rights, and financing. While the actual construction of the homes is a factor in the overall price of the home, it's important to realize that the previously mentioned hurdles are the greatest contributors to high prices. Nevertheless, it's important to cut costs in all areas.

Obviously large-scale developments benefit from economies of scale. Materials purchased in bulk and contractors working on several projects at once cut costs in ways that a single small home construction wouldn't be able to do.

Additional cost cutting for Amani Village will come in the selection of materials. The building material of choice in Coast Province is coral blocks. The coral is quarried along the coast, cut into rough blocks, and slapped together with large amounts of mortar. Coral block is a strong material with great thermal properties but is becoming more expensive as the reserves of coral are depleting. The added expense of excessive mortar between the roughly cut stones makes coral block building quite expensive when compared to different technologies.

Homes at Amani Village will be built using compressed earth blocks. The technology is gaining popularity and use across the developing world. Sand, soil, and cement are mixed together and compressed into a formed interlocking brick. The sand and soil can be found on site from the excavation of foundations, and the cement will make up a mere 5% of the finished product. The result is a highly durable, cheap, and eco-friendly building material. Two prototype homes have been constructed by the Asante Foundation using earth bricks. The interlocking system built into each brick allows them to be placed without expensive mortar. The cost savings of using these bricks over coral blocks is 50%. Below are the costs budgeted for each model.

Cost Breakdown per Model

Description	Sqft	Cost of Infrastructure	Cost of Land	Cost of Construction	Total Cost	Cost/sqft
1 Bedroom A	277	1,201	160	1,286	2,647	9.55
1 Bedroom B	368	1,598	213	1,498	3,309	9.00
2 Bedroom	550	2,388	318	1,706	4,412	8.02
3 Bedroom	924	4,012	535	2,954	7,500	8.12

Table 2: Cost Breakdown per Model. Source: Authors

Legal Structure

The cost and process of subdividing property into small lots is out of the question. The current system of land registration and division simply doesn't work for the average Kenyan. It's tedious, costly, and lengthy. The solution Amani Village is proposing is to create a legal entity similar to those required of high rise apartment buildings. Owners of apartments don't actually own the land that their apartment sits above. Kenyan law allows for the sub-leasing of property through stock ownership. Each customer of Amani Village will purchase a share in a joint company that owns the property. With the purchase of each share comes a specific home. The homes will be sub-leased to the client for 99 years. The lease can be renewed at the end of the time period with first priority given to the owner. The client has legal rights to their share in the company and physical ownership of their home.

This set up reduces costs in several ways. First it reduces the costs, headache, and wait time of buying and selling property through traditional established avenues. Secondly, it gives the community control over buying and selling. The community will have the option to vote each time a home is bought and sold. This allows the community to choose who lives in the development, providing clients with an added sense of security and value. Third, it gives responsibility of maintenance and property management to the owners. Monthly home owner's association fees will be collected to pay for maintenance of the infrastructure, security, and the overall upkeep of the development. With the entire community contributing to the upkeep of the development, properties at Amani Village will increase in value and become an appreciating asset to each owner.

Mortgage Details

Amani Village homes will be sold to qualified buyers. While some homes will be paid for in cash, the majority will likely be financed via mortgage through local mortgage lenders. To date formal discussions with Equity Bank, Co-operative Bank of Kenya, and Kenya Commercial Bank have yielded positive results. Kenyan banks recognize the need for servicing the low-cost housing market and are eager to partner with developers to expand their loan portfolios to an largely untapped market.

Current mortgage rates in Kenya are between 13.75% and 14.25% on 10 year mortgages. The target market for Amani Village buyers are households making between 2,600 and 7,400 USD per year. Smaller models will of course be cheaper than larger models. Customers should spend no more that 25% of their monthly income on housing. See chart below for monthly mortgage details.

	1 Bedroom A	1 Bedroom B	2 Bedroom	3 Bedroom
Sales Price	3,530	4,410	5,880	10,000
*** Monthly Mortgage Payment**	**54**	**68**	**90**	**154**
Target Market Monthly Income	217	271	362	615
*** Calculations based on an interest rate of 13.75% APR over 10 years**				

Table 3: Monthly mortgage details. Source: Authors

Financial Overview

As with any realistic and scalable development project, Amani Village must be financially successful. The goal is to provide a replicable framework that can be copied and scaled across the country. To accomplish this, Amani Village will create low-cost houses and sell them at a profit that is socially responsible yet attractive to investors and developers. Homes at Amani Village will be sold at a 25% margin above the costs of construction and development. The smallest model (277 sqft) is budgeted to sell for 3,530 USD and the largest model (924 sqft) for 10,000 USD. Below is a breakdown of profits by model, a proforma income statement, and statement of cash flows.

Square Footage, Sales Price, and Profits for each Model

Description	Total Cost	Sales Price	Profit
1 Bedroom A	2,647	3,530	882
1 Bedroom B	3,309	4,410	1,103
2 Bedroom	4,412	5,880	1,471
3 Bedroom	7,500	10,000	2,500

Table 4: Square Footage, Sales Price, and Profits for each Model. Source: Authors

Proforma Income Statement			
	Total Costs	**Sales Revenue**	**Net Income**
1 Bedroom A	34,412	45,882	11,470
1 Bedroom B	95,956	127,941	31,985
2 Bedroom	44,118	58,824	14,706
3 Bedroom	37,500	50,000	12,500
Commercial	17,647	23,529	5,882
Nursery School	7,941	10,588	2,647
Total	**237,574**	**316,764**	**79,190**

Table 5: Proforma Income Statement. Source: Authors

Amani Village Proforma Cash Flows 2010 - 2011									
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Cash Out									
Infrastructure and land	19,500	14,000	20,000	10,000	14,000				
Unit Construction					18,978	26,405	20,467	55,707	24,438
Cash In									
Unit Sales					41,573	57,584	44,382	126,404	32,584
Cash Flow	**(19,500)**	**(14,000)**	**(20,000)**	**(10,000)**	**8,595**	**31,178**	**23,915**	**70,698**	**8,146**

Table 6: Amani Village Proforma Cash Flows 2010 – 2011. Source: Authors

3. Low Cost: Eco-Conscious

Recently, the global environment problem has become aggravated, and it should be required, in the built environment field, that all buildings utilize natural energy and minimize fuel energy consumption. In this regard, various anecdotal research findings have found that the most successful, long term, low-income housing projects are those that use sustainable design and address the social, cultural, and economic needs of residents.

The Amani village is developed under warm-humid climate described as the 'best yet hard to design for'. With the aim of ensuring that the units are passive, an evaluation of human thermal requirements were carried out with the aid of three thermal indices. The Mahoney tables recommends that (1) a north-south orientation with the east-west axis being the long axis, (2)

allowance for open spaces to allow for breeze penetration, (3) single banked rooms, (4) light walls with short time lag and (5) use of light roofs. The design approach and construction technology of the village in response to the above environmental requirements are discussed and elaborated by the images below;

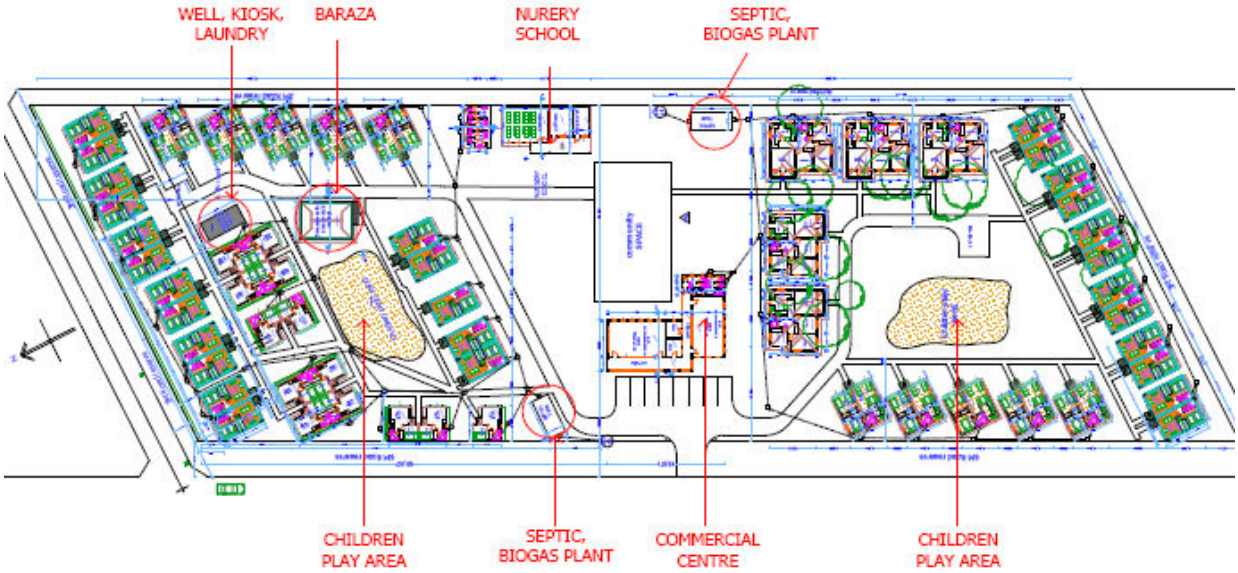

Figure 2: Master plan of Amani village. Source: Authors

Figure 3: Images of the proposed Amani village. Source: Authors

Positioning of the buildings on site was governed by the actual location of trees on site to ensure that only countable trees will be brought down during construction. The character of the Village is a resultant product of the interrelationship of various elements, creating a distinctive recognizable area defined by dwellings, walkways, open spaces and social/commercial institution. The area taken by the roads (hard landscape) have been reduced to less than 4% of the total area of the site ensuring minimal surface run-off as rainwater will have adequate area to percolate.

From the master plan above, it is apparent that the general orientation of most buildings is north-south. All the main windows have been positioned to face either north or south. This minimizes the sun penetration to the interior spaces from the openings and further allowing the design to incorporate openings that allow in fresh breeze. Chances of the inner spaces

overheating during the day are thus minimized. More so, more consideration was given to the design of the windows. The casement type windows are mainly vertically oriented with height to width ratio of approximately 2:1, and a setback of 100 millimeters from the façade. The windows are divided into two by a transom with the top part made of horizontal timber louvers and glass panels whilst the lower part of timber panels. In overall, the windows will ensure control of light indoors, maintain privacy and cross ventilation.

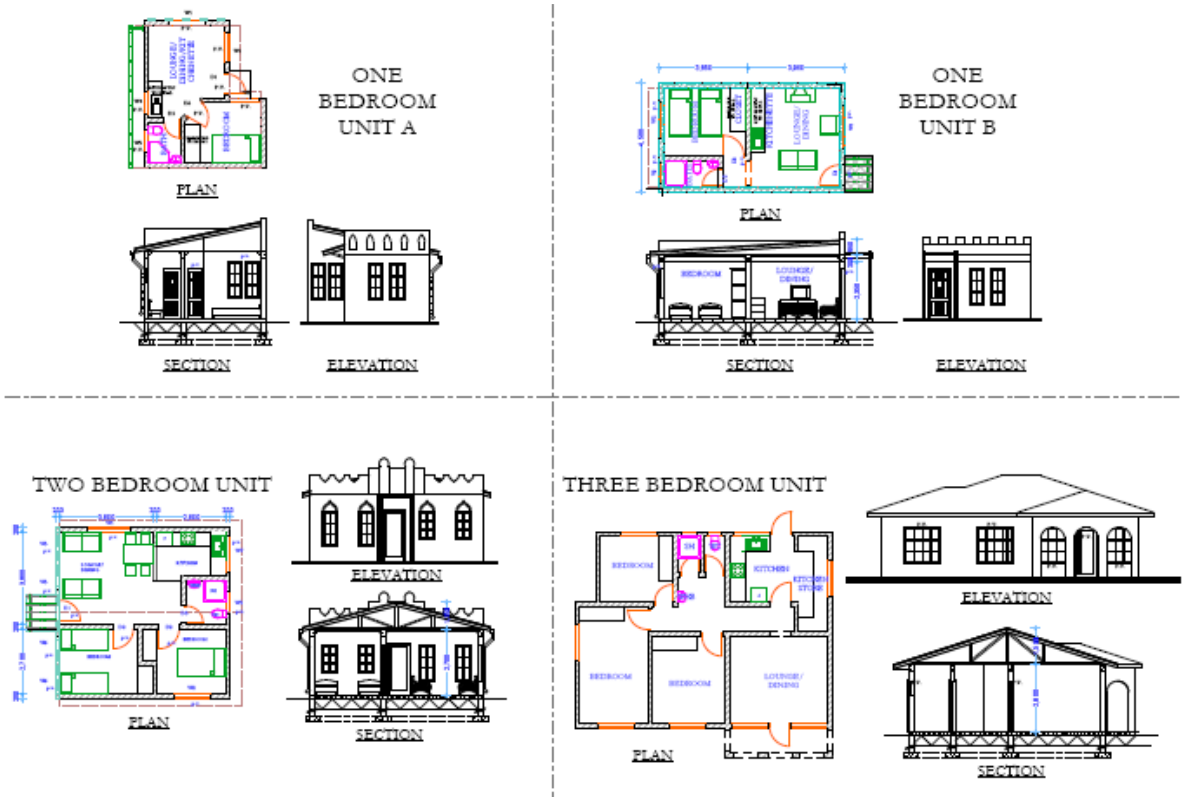

Figure 4: Drawings of the units. Source: Authors

Grey water from each unit is directed to water recycling plant shared by every five buildings. The plant is made of 100 litre platic water tanks filled with stones of various sizes. The output, soap-free clean water, is drained to the gardens owned by the residents.

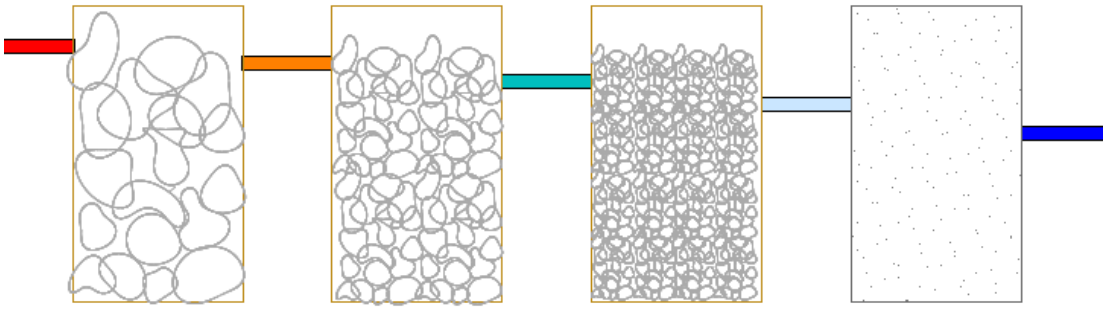

Figure 5: Schematic layout of grey water recycling plant. Source: Authors

With hardwood timber species like teak and oak getting extinct, the project has opted for bambakofi and coconut wood as substitute materials with the latter depicting characteristic of physical and mechanical properties both over-section and height. The wood, some obtained within the site, will be used for structural elements like roof trusses.

The building wall structure will be made of compressed earth blocks made on site from the excavated soil and will have an average thickness of 220mm. These walls which will be faced, in a pattern, with white lime stucco will give a pleasant homogeneity to the overall appearance of the development from the streets. The calculated thermal performance of the wall is a time lag of approximately 8 hours which will ensure comfortable indoor thermal conditions during day and night.

A span of a typical room has been designed so as not to exceed 3.5 metres especially in the single bedroom units in order to ensure the ends of the trusses are incorporated directly in the walls for structural support. This will as a result save more than 800 linear metres of wall plate timber. The ceiling surface will be rendered between the joists with recycled cardboard, at no selling price, from local vehicle assembling company. The ceiling will minimize penetration of heat from the roof surface into the habitable spaces.

On matters roofing, traditionally, most of the buildings were constructed with flat roofs and *makuti* thatch. The materials did not last long because of the high rainfall levels experienced. In this regard, galvanized iron sheets will be used, initially used as containers for imported vehicle spare parts. The sheets, which are in good condition, will reduce the cost of roofing by almost half.

In addition, the project will construct a biogas plant to provide cooking gas to the two and three bedroom units as well as allowance for at least $2m^2$ photovoltaic solar panel at the roof level for running electric appliances.

4. Conclusion

Efforts are in place by various players to ensure decent housing to the bottom of the pyramid. However, such efforts are unfortunately dampened by stringent regulations and procedures at the approvals at the government level. The project has shown that affordable and sustainable housing project is viable through careful consideration of the prevailing climate, materials and flexible financing options.

The next paper will provide a post-occupancy analysis of the project.

Authors:

Peter Njeru Njue, University of Nairobi, Department of Real Estate and Construction Management, Kenya

Taylor Mackay, Accountant and Program Manager at Asante Foundation, Kenya

References

Baker V. (1987): *Passive and Low Energy Building Design for Tropical Island Climates*. The Commonwealth secretariat

Beyer G. (1969): *Housing and Society*. Macmillan Company, New York

Chappels H.; Shove E. (2004): *Comfort; a Review of Philosophies and Paradigms*

Cities and Climate Change. Initial Lessons from UN-HABITAT. Brochure

Hooper C. (1975): *Design for Climate. Guidelines for the Design of Low Cost Houses for the Climate of Kenya.* Kenya Building Centre

Njeru P. (2007): *Human Thermal Comfort in Swahili Urban Buildings, A Case Study of Old Town Mombasa*. University of Nairobi

Njue P & Kimeu M. (2010): *'Impenetrable' Urban Maze of East African Coastal Towns: Its Implications on Climate Change*. 46th ISOCARP Congress Proceedings

Payne G., Majale M. (2004): *The Urban Housing Manual: Making Regulatory Frameworks Work for the Poor*. Earthscan publications.

Rapoport A. (1980): *Vernacular Architecture and the Cultural Determinants of Form*. Buildings and Society