Pre-feasibility Study for Establishing Clay Brick Factory Dodoma, Tanzania

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Client: BUILD AFRICA HOLDINGS LTD

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Introduction

Since independence Tanzania is battling towards three development enemies; poverty, ignorance and diseases, with deepening rural poverty it is adamant that the need to provide housing for the poor is highly imperative if they are to win the poverty battle. This study aims to explore the viability of using clay building material an alternative to cement for constructing houses and create sustainable human settlements in urban and rural areas. Viability in the context of this study entails the willingness and ability to acquire clay materials if available, the return on investment for the financier, construction of houses in accordance with applicable legislation and the conduciveness for sustainable human settlement.

Against the background of a problem analysis concerning, high housing construction costs; inadequate technology to allow bulk supply for building materials, issues relating to land, access to housing finance, stringent regulatory frameworks; difficulties in procuring building materials; inadequate skilled construction workers; less awareness on access and adoption of appropriate housing technologies; the Client commissioned *Pre-feasibility study for establishing Clay Brick Factory in Dodoma, Tanzania.*

Build Africa Holdings Ltd is aware that It is only clay building material able to transform housing industry and facilitate construction of affordable housing in Tanzania. This study is intended to explore the feasibility for developing the Dodoma Clay Brick Project which apart from manufacturing clay bricks it will also manufacture clay roofing tiles, pavers and water tanks.

Objective

The purpose of this study is to increase understanding on housing building material especially clay resource, as a successful component on accelerating delivery of housing in

rural and urban areas in order to upgrade the living conditions of the people. The objective of this assignment is to assess the use of available clay resources as an alternative building material and adoption of new technologies to bring down high construction costs, but at the same time facilitate affordable housing in Tanzania.

Scope of work

The Terms of Reference outlines the scope of work for this assignment to include the following items:

i. Identify locations and type of clay materials available and kind of technology used for manufacturing various building materials, such as bricks and roofing tiles.
ii. For identified locations, clay materials and technologies in (i) above, assess its potential use in Tanzania, based on durability, financial implications, job creation impact, housing affordability impact, and environment impact.
iii. Based on the results of (ii) above propose methodology which should be considered for small, medium and large-scale operations in Tanzania to cater increasing demand for housing in Tanzania and within the east African region.
iv. Preliminary Factory Design and Cost Estimates;
v. Financial viability of the project;
vi. Stakeholder participation;
vii. Preliminary Environmental Review.

Identification of place with potential clay sites

A number of potential location sites in various regions reviewed and data collected on the available places containing size of clay deposit area, provision of necessary infrastructure (fuel, water, electricity) connectivity to road and rail, access to potential market and social/environmental aspects. This has resulted Dodoma seen as potential location for clay brick Project in Tanzania. (see Figure 1)

Clay site selection

The following criteria applied in the site selection analysis:

i) Availability of land,

ii) Distance of clay deposit area from settlements;

iii) Physical terrain;

iv) Accessibility;

v) Social and employment issues;

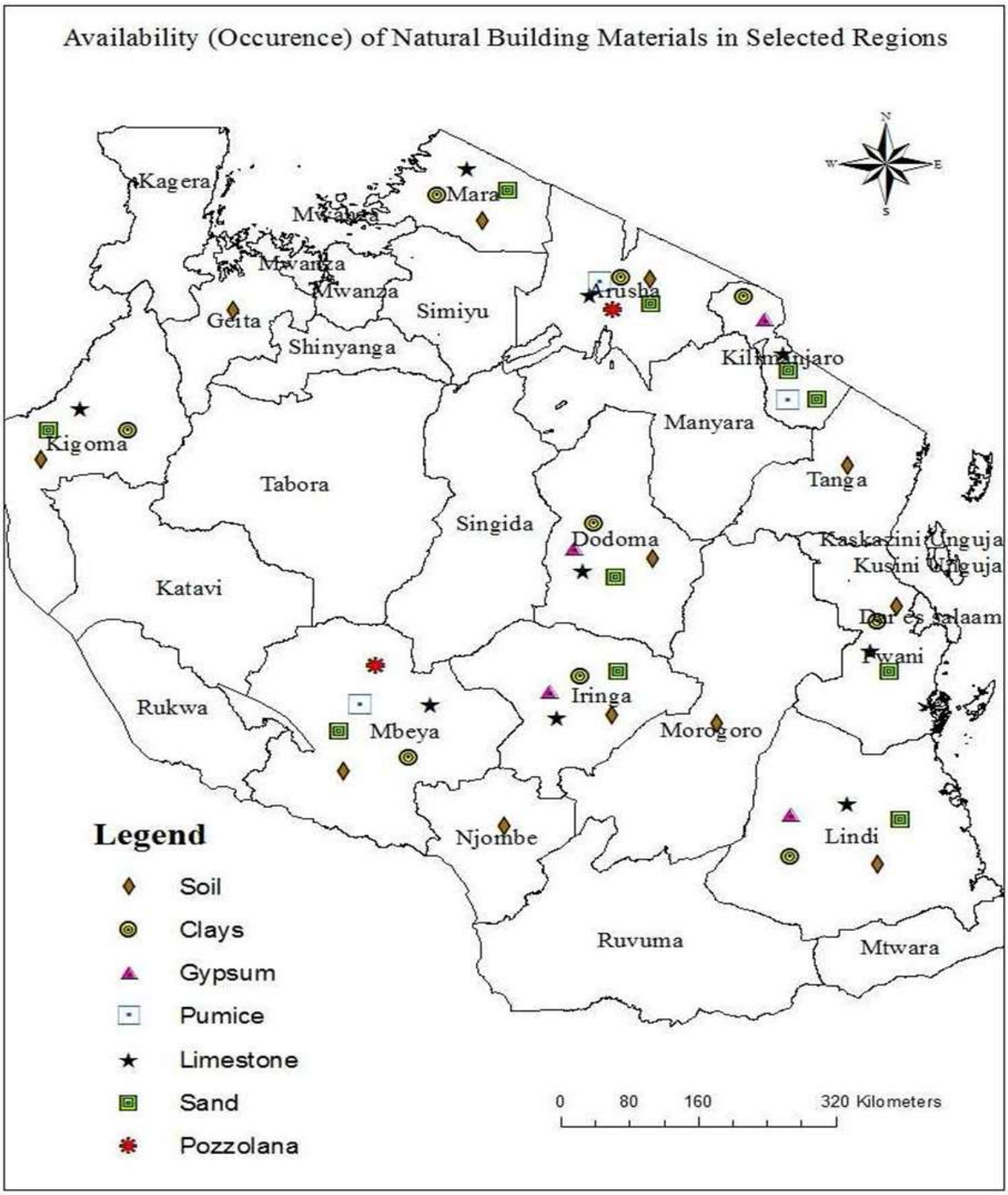
vi) Proximity to essential social services;

vii) Construction cost;

viii) Safety and Environmental conditions at the site level.

A multi criteria analysis was carried out based on certain weighing of criteria set by the Consultant in discussion with BAH, Local villages and ward leadership and other stakeholders especially the Mining Commission and the Geological Survey of Tanzania (GST). After reviewing clay sites available in Dodoma district visually and technically, it became evident that sites located in Mbabala Ward was considered the preferred place based on historical background that between 1950 to 1975, there were clay manufacturing activities within the area, but also terrain attractiveness and investment costs.

Figure 1: Building Materials in selected Regions



Source: Ardhi University, 2014

Table 1: Natural Building Material in selected Regions in Tanzania

S/No.	Region	Limestone	Gypsum	Clay	Soil /laterite soil	Sand/stone chippings	Pozzolana	Pumice
1	Arusha	Yes	NA	Yes	Yes	Yes	Yes	Yes
2	DSM	Yes	NA	Yes	Yes	Yes	NA	NA
3	Coast	Yes	NA	Yes	Yes	Yes	NA	NA
4	Dodoma	Yes	Yes	Yes	Yes	Yes	NA	NA
5	Iringa	Yes	Yes	Yes	Yes	Yes	NA	NA
6	Kigoma	Yes	NA	Yes	Yes	Yes	NA	NA
7	Kilimanjaro	Yes	Yes	Yes	Yes	Yes	NA	Yes
8	Lindi	Yes	Yes	Yes	Yes	Yes	NA	NA
9	Mara	Yes	NA	Yes	Yes	Yes	NA	NA
10	Mbeya	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	Morogoro	NA	NA	Yes	Yes	NA	NA	NA
12	Tanga	NA	NA	Yes	Yes	NA	NA	NA
13	Songea	NA	NA	Yes	Yes	NA	NA	NA
14	Mwanza	NA	NA	**Yes**	**Yes**	NA	NA	NA
15	Manyara	NA	NA	**Yes**	**Yes**	NA	NA	NA
16	Geita	NA	NA	**Yes**	**Yes**	NA	NA	NA

Source: Ardhi University, 2014

Dodoma Region

Dodoma Region is located in the Central part of Tanzania, having an area of about 41,311Km^2, situated between DMS latitude longitude coordinates 6°10'19.96"S, 35°44'22.09"E. It is the Capital City of Tanzania, endowed with considerable wealth in natural resources, with a record of over 3 minerals of proven reserves. According to geological surveys carried out such deposits includes, Limestone, Clay, Heavy mineral and sand (Gypsums). These minerals have some prospect for industrial use. However, clay minerals appear not to be the most valuable among the minerals of the earth surface, yet they affect life on earth in far reaching ways. Clay is used in the manufacture of refractory products such as firebricks and blocks, insulating bricks, refractory mortars and mixes, and monolithic and castable materials. There is substantial huge deposit of clay in Dodoma Region. The recent survey indicates, clay deposit in Dodoma Urban may cover approximately 115.7959km^2 extending from Zuzu, Chididimo, Bihawana, Chizomoche,

Isanha to Mwitikira Village in the Bahi District. Two brick factory were established within this area.

Clay Brick Factory

The clay brick factory comprises a plant to manufacture bricks, roofing tiles, water tanks, pavers and joinery accessories using clay. Through technology, the factory can manufacture 500,000 to 1,000,000 bricks per day. It is expected that, clay building material produced in Tanzania may drive down high construction costs, originates from overreliance on cement products. Clay building material facilitates greater speed in the construction process, eliminating embedded hidden indirect costs when using cement materials. Much greater, the material produced, largely contributes on conserving the environments by reducing excessive use of sand, gravel and water associated with excessive use of cement.

Financial feasibility

The basic assumptions for the financial feasibility of the base case as well as the results are presented below:

Table 2: Assumption Timing of the Project

Parameter	Assumption (Base case)
Number of concession years	8
Construction starts	01 January 2019
Construction ends	31 December 2019
Operation starts	01 January 2020
Concession ends	31 December 2026 (related to number of concession years)
Repayment starts	A grace period is assumed
Days per year/period assumed	365/366

Source: GCG

Investment costs for clay brick factory consists of land, buildings, plant and equipment, motor vehicles, office equipment, furniture and fittings, pre-operating expenses and working capital. These capital costs for basic infrastructures amounts to **USD 53.6 million** in total.

The Project feasibility is assumed hereunder:

i) The cost base charges (DOC) for material productions are calculated.

ii) A margin is added to these charges to reach the desired RoE and IRR of the project.

iii) The resulting brick price is compared with other building material available in the market including vibrated cement block.

iv) The feasibility realized that, the selling price per clay brick is USD 0.24

Stakeholders Participation

The community perception for the project is good and most of the people wish to see immediate implementation of the project, but they are worried of compensation rates for their valuable land and other properties. They require fairness and transparency throughout the whole process, especially on compensation issues that, any land or property should not be occupied by the project unless compensation is fully completed.

Environmental Review

Issues pertaining to clay mining and brick manufacturing and its environmental and social consequences were discussed with key stakeholders. They asked to inform and prepare affected individuals particularly villagers within Mbabala ward, to participate in the scheduled public meetings at the time when EIA stage will be initiated. Issues raised forms a basis for developing a feasibility to be used in determining mitigation measures for the project.

Review Methods

Based on the study done in 1971 by the Geological Survey of Tanganyika, Tanzania is endowed with huge clay deposit in various places.

On this regard, this study intends to review on the Clay availability, workability, material cost, clay thermal properties, sustainability and clay material production scalability. However, the study goes to identify various development patterns of clay material occurrence, conducting preliminary laboratory testing for various clay material samples to establish its fine qualities, hence determine proper production technology, and finally provide solutions as to what to manufacture, where and at what scale.

Conclusion

Of different clay locations surveyed Dodoma was considered the best location for setting clay brick manufacturing factory due to its vicinity to source of fuel (Coal extraction sites) and potential market for building material. Further, the terrain structure which, though flat

and relatively having narrow shaped hills, is much better geo-technically structured than any other locations.

The Mbabala site in Dodoma offers ample space for both, clay mining and industrial activities. Hence, due to its distance from human settlements, air and noise pollution will be avoided.

Recommendations

Based on the above conclusion the consultants recommend the following:

i. Preparation for Project Technical proposal to Investigate further, the geo-technical features of Mbabala site and the potential clay industrial development activities in the area.

ii. Execute an economic feasibility study (Project Profile) to assess the wider economic effects of clay brick factory in Dodoma; and

iii. If possible, prepare the necessary legal and institutional concession framework for clay brick project after full economic feasibility study has been undertaken.

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1.0 Introduction

Located in East Africa, Tanzania is a country bordered by Kenya and Uganda to the north, Rwanda, Burundi and the Democratic Republic of the Congo to the west; Zambia, Malawi and Mozambique to the south, and the Indian Ocean to the east.

Figure 2: Map of Tanzania

It has an area of approximately 945,087 square kilometers and a population of about 58.4 million, for a total population density of approximately 62 persons per square kilometer. Most of Tanzania is dominated by a large central plateau, one covered with grasslands, plains and rolling hills. The country is mountainous in the far-northeast, where Mount Kilimanjaro, Africa's highest peak is located, with high plateau covering the southern highlands terrain. This high elevation makes for a subtropical climate, and average temperatures range from 15°C in July to 21°C in January.

The country is divided into thirty-one regions, including five regions from the Islands. Its capital city is Dodoma, while Dar es Salaam is now a commercial city.

Tanzania is a growing economy, straddling in the East African and Southern African economic development communities. The country is one of the fastest growing countries on the African continent and is rich in natural resources. At least 31.6 percent of the country's 58.4million people live in urban areas, with a population growth rate of almost three percent and urbanization rate of five and a half percent per annum.

The country has experienced impressive GDP growth rates over the past decade averaging almost seven percent per year. The GDP grew by 7.1 percent in year 2015, higher than the growth of seven percent in 2014, with the rate is projected to remain at approximately seven percent through year 2020. Strong and sustained economic growth, coupled with a fast-growing population (expected to more than double by 2050) have greatly contributed to the fast growing housing sector demand. Housing demand has also been boosted by easier access to mortgages, with the number of mortgage lenders in the market increasing from 3 in 2009 to 28 by June 2016, and the average mortgage interest rate falling from 22 percent to 16 percent. Inflation rates have portrayed a decreasing trend in the first four months of 2018 with the rate picking up to reach 5.5 percent in the month of June mainly due to rising food cost. These movements have gone hand in hand with movements in the 182 days Treasury bill rate which experienced an upward trend during the first quarter end towards the end of the second quarter of 2018. The rising trend on the 182 days Treasury bill rate negatively affected all forms of long term debt, including mortgages by making them more expensive. The government has however expressed its commitment to ensure loan interest rates are reduced in order to enable many Tanzanians to acquire loans.

With such impressive mortgage facility performance, statistics shows housing affordability ratio as low as 6.4%, and the annual average household expenditure outweighing the household income by more than 50% it would be difficult for the low-income earner in Tanzania to rent let alone save to build a house. There's need to change this situation, through giving people a type of building material, locally manufactured with that technology allows to undertake mass production to exploit on the volume so to make its price much cheaper.

This study therefore, intends to provide a broad picture of the current situation on the availability and use of housing building material resources in Tanzania. Hence propose solutions to address matters pertaining to the housing industry in general, including high

construction costs, lack of proper technology, even lack of sector capacity to deliver housing.

All too often, housing is much more than just the physical dwelling units - it must be seen not only as an integral part of the physical environment, but also as a process within the socio-economic fabric of society. Taken in this context housing must be seen as an indicator of social development for it provides a vehicle through which people can improve, in absolute terms, their material condition as well as their social and psychological well-being. This implies that housing must be seen as a means of job creation, employment stimulation, training and so on and not merely as a shelter.

2.0 Building Material Resources availability in Tanzania

In Tanzania the main building material resources available includes land, sand, clay, limestone and forests, which are transformed into mud and poles, mud bricks, burnt bricks and cement bricks to be used for construction of houses. Fig. 3 below presents the distribution of households by main materials used for housing construction. As it shows, people prefer burnt bricks more than other building materials (27.3 percent). This trend brings an attention and opportunity that, new technology is required to transform the entire process of manufacturing burnt bricks which is done manually, slow, inefficient and linked to environmental destruction. This new technology which will improve burnt bricks manufacturing process on aspect of quality and quantity using coal or natural gas as fuel on firing process. As will see later from the statistics, burnt bricks in Tanzania are manufactured using local made devices, the manufacturing is characterized by informal practices difficult to regulate. It is associated with the reduction of farming areas, deforestation, excessive use of water from the sources providing water for domestic use and for animals, but further, leaving pits as mosquito breeding places. It is cheap, but destructive. However, it can be improved through using clay materials available to respective places, to manufacture bricks in a formal style and in a sustainable way.



Figure 3: Distribution of households by main materials used for housing construction

House Wall	Dar es salaam			Other Urban areas			Rural Areas			Tanzania Mainland		
	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12	2000/01	2007	2011/12
Poles, branches, grass	0.9	1.5	0.0	5.3	4.6	0.2	19.3	16.9	1.0	16.0	13.0	0.7
Mud & poles or stone	5.2	4.7	2.5	13.1	10.9	11.9	21.8	22	31.1	19.4	18.2	23.6
Mud only	2.2	1.9	-	12.1	10.3	-	18.1	12.0	-	16.1	10.7	-
Mud bricks	3.2	1.3	0.3	30.8	22.6	19.0	23.5	26.4	31.0	23.3	23.2	24.7
Baked or burnt bricks	1.3	1.6	0.2	15.9	29.9	42.0	13.7	18.8	28.1	13.2	19.3	27.3
Concrete, cement, stone	87.2	88.3	96.9	22.4	20.7	25.8	3.0	3.1	5.0	11.5	14.8	20.9
Other	0.0	0.5	0.1	0.4	1.0	1.0	0.6	0.9	3.8	0.5	0.9	2.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: NBS (2012) National Census

3.0 Clay Building Materials in the SADC Region

The Southern Africa Development Community (SADC) constitutes 16 member countries. Out of 16 countries, 11 countries including Tanzania are endowed with clay resources. Annual clay bricks production in SADC countries is 5 billion clay bricks, manufactured by 151 factories (Fig. 5), with some factories having massive production approximately 10 million bricks per month. With the capacity to produce 5 billion clay bricks in the region, these 151 factories have created approximately 315,000 direct job opportunities, implying 2,100 jobs for a single clay brick factory. This implies, clay building material industry is a good source for employment creation. Tanzania almost equal to South Africa in terms of population size, produces 1% of clay bricks produced in the region compared to 72.3% produced by South Africa, but also having the lowest bricks per capita in the region. This poor performance in Tanzania needs transformation through mechanizing the brick manufacturing process as other countries in the region.

Figure 4: Clay Bricks Manufacturing Capacity in SADC member Countries

Countries	Bricks per year	Population	GDP (PPP) billion	Bricks per capita	Bricks/GDP per capital
Angola	300 000 000	25 789 024	194 055	12	39 869
Botswana	187 000 000	2 155 784	38 819	87	10 385
Lesotho	18 000 000	2 067 000	6 017	9	6 183
Madagascar	150 000 000	24 200 000	9 981	6	363 691
Malawi	50 000 000	16 407 000	21 843	3	37 557
Mauritius	-	1 348 242	23 322	-	-
Mozambique	100 000 000	24 692 144	36 925	4	66 871
Namibia	20 000 000	2 113 077	26 399	9	1 601
Swaziland	18 000 000	1 119 000	11 077	16	1 818
Seychelles	-	92 000	2 657	-	-
Tanzania	50 000 000	51 820 000	150 633	1	17 201
Zambia	33 000 000	16 212 000	65 493	2	8 169

Zimbabwe	450 000 000	13 061 000	28 918	34	203 245
South Africa	3 600 000 000	54 956 900	742 461	66	266 472
Total	**4,976,000,000**	**417,109,442**			

Source: Swisscontact, 2017

From Fig. 6 statistics indicates that, out of 11 SADC member countries having clay resources, 6 countries prefer clay, 4 countries use cement while 1 country prefer other construction material. Further, it is only Tanzania, clay bricks are produced by the informal sector using wood, charcoal and rice husk as primary source of fuel to fire bricks. These sources of fuel are highly linked to deforestation especially in rural areas. In all other countries clay bricks manufacturing process is mechanized and highly regulated, having small informal sector dealing with clay bricks, that is environments destructions is minimal. On the other side, Tanzania relies heavily on cement. This over dependence on cement, increases construction costs in the sense that, when demand is higher than supply price goes up. This trend is therefore unsustainable, there must be an alternative for cement, locally available option. Clay in this context is highly recommended.

Figure 5: Building Material and Technology applied in SADC Region

Countries	FORMAL SECTOR			INFORMAL SECTOR		BUILDING MATERIALS		
	Factories	Main Technologies	Primary Fuels	Market	Primary Fuels	Clay	Cement	Other
Angola	10	Tunnel, Hoffman	Oil, Coal	10%	Wood, Charcoal	60%	30%	10%
Botswana	4	Tunnel, Clamp kiln	Oil, Coal	5%	Fly Ash	69%	30%	1%
Lesotho	1	Tunnel	Oil & Coal	25%	Coal, Fly Ash	20%	75%	5%
Madagascar	10	Tunnel, Scove, Hoffman, Clamp, Zig Zag, BTK	Rice Husk, Wood Peat, Agricultural waste, Coal, Ash	25%	Farm Waste, Wood Peat, Ash, Coal, Rice Husks	60%	20%	20%
Malawi	4	VSBK, Clamp, Tunnnel, Scove, BTK	Wood, Coal, Saw Dust, Rice Husk, Agricultural waste,	50%	Charcoal, & Wood	40%	5%	55%
Mauritius	0	-	-	0%	0%		100%	0%
Mozambique	2	Hoffman & Clamp	Coal	50%	Charcoal, Wood, Farm waste	40%	40%	20%
Namibia	3	Clamp, Hoffman	Coal, Charcoal, Fly Ash, Wood	0%	-	20%	78%	2%
Swaziland	1	TVA	Coal & Fly ash	0%	-	5%	90%	5%
Seychelles	0	-	-	0%	0%		100%	0%
Tanzania	0	-	-	100%	Wood, Charcoal, Farm waste, rice Husk, Cotton Wastes	20%	60%	20%
Zambia	2	Tunnel, Clamp	Saw dust, Fly Ash & Charcoal	10%	Wood, Charcoal & fly Ash	10%	80%	10%
Zimbabwe	9	Clamp, TVA, DDK, Hoffman, Beehive	Coal	15%	Coal, Charcoal, Wood Fly Ash	70%	25%	5%
South Africa	105	Clamp, Tunnel, Hoffman	Coal, Fly ash, Oil, Diesel, Gas	5%	Coal, Wood & Fly Ash	45%	45%	10%

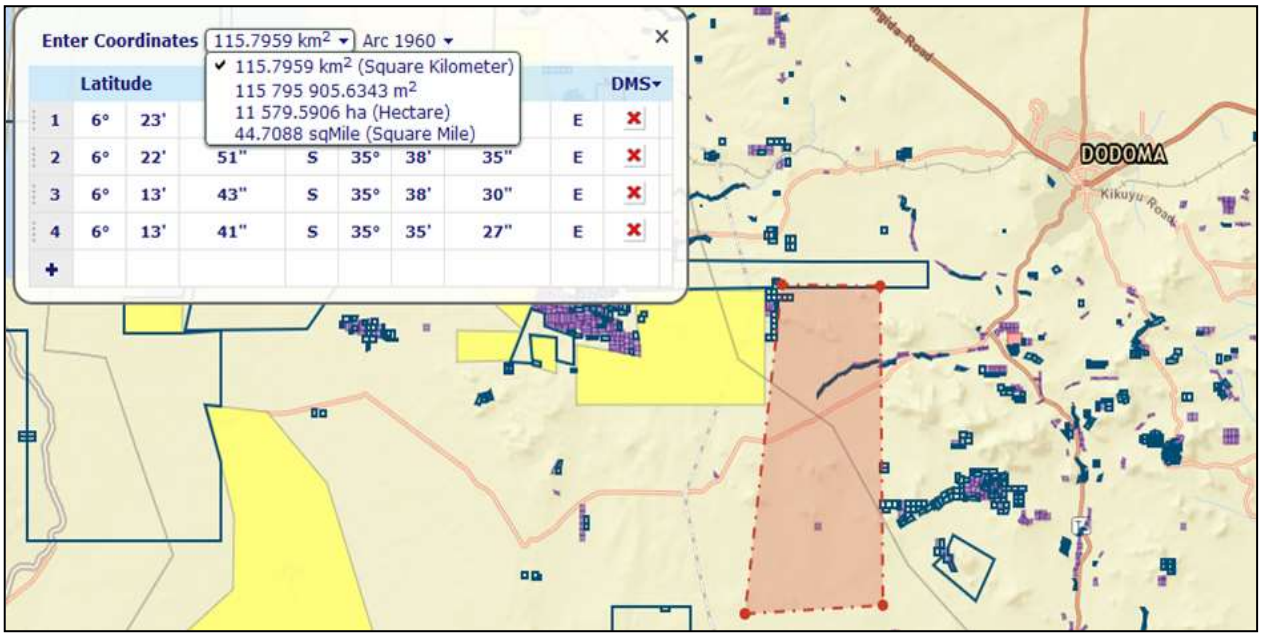
Source: Swisscontact, 2017

4.0 Location Description and Existing Environment

4.1 Project Site

The Project site is in Mbabala, Bihawana, where old brick factory owned by Catholic white Fathers from Italy, was built. The coordinates of the project are as indicated in fig. 6 below.

Figure 1: Project Location



Source: Regional Mining Office Dodoma, 2018

4.2 Climate, Topography, Vegetation and Drainage System

The climate of Dodoma region is semi-arid, characterized by a marked seasonal rainfall distribution with a long dry and short wet season falling through December to April each year. The calculated total annual rainfall ranges between 550-600mm per year. Average temperature varies from 200C in July to 300C in November each year. The highest temperature is 32C while the lowest is 14C. Due to the semiarid nature of Dodoma, most places are characterised by dry wind during July to November.

Topography: Large part of Mbabala extending through Chizomoche, Isanha to Mwitikira is characterized by broad upland plains which are part of the Central Plateau. The Plains shelve gently down to mbuga swamps and separated by ranges of hills and

isolated rock outcrops. The existing hills rise about 200 metres above the general level of plains. The area is tropical by nature with high temperatures during the dry season. Wind speed is usually high in dry season compared to wet season.

Vegetation: In their natural form, the plains of Mbabala are marked by open grassland with little or no tree or bush cover. Due to the erratic nature of the rains and strong radiant heat of the sun, much of the grass is sparse, except in the low-lying areas. Most common, however, are wooded grassland and bush land with thickets. In many areas there are scattered small farms and grazing spaces. The bush tends to be leafless and drab in the dry season, but springs during the rains when the entire place turns green. Woodlands form the remainder of the area, with scattered emergent baobab trees and other natural trees growing on rocky soils.

Drainage: There are small streams within Mbabala which are usually dry throughout the year, except during heavy rains seasons when they collect most of the runoff from the hills and foot slopes and store this water in the sandy stream beds or drain it into the swamps where it evaporates or feeds groundwater reservoirs.

Table 3: Hydrogeology conditions and status in Mbabala, Bihawana.

	Condition	**Status**
i.	General groundwater potential	Low to moderate
ii.	Abstraction facilities	Boreholes, deep and shallow wells
iii.	General water strike range	15-60 Meters
iv.	Borehole depth	40-70 Meters
v.	Deep well depth	10-20 Meters
vi.	Shallow well depth	<10 along river channels and low laying
vii.	Areas	-
viii.	Water level range	5-30 Meters
ix.	General average yield	0.02-2.0 litres / second
x.	General water quality	Good for human consumption, crops etc.

Source: GCG

Hydrology: The site lies within the catchment of streams supplying into a small Bihawana river which leads to Bahi district. All of the water courses are seasonal.

Soils: The area was assessed of its soil physical properties. The results obtained are presented in the table below:

Table 4: Soils properties

Depth/cm	Texture	Structure	Consistence	Roots	Stones	Mottles and concretions
0-20	Sand	Subangular	Very hard	Numerous	None	None
50-70	Sand	Subangular	Hard	Few	Found	Greyish
150-170	Sand	Prismatic	Soft	Very few	Few sub-rounded	concretions

Source: GCG

4.3 Biodiversity Assessment

This area is characterized by huge and extensive undisturbed biodiversity. Naturally, this type of the project is inherently a destructive activity since it lands clearance and clay mining, therefore there will be some environmental damage– mitigation methods needed to minimize the extent of the effects.

4.4 Social impact assessment

The establishment of clay brick manufacturing activities may carry social effects to the population of Dodoma. In all of the pre-selected sites residential areas and/or economic activities were observed, such as grazing areas, farms, planted trees and temporary houses. Project activities will imply the relocation of these structures. Any eventual resettlement is inevitable due to the vicinity of the project to these human developmental activities.

4.5 Labour market issues

In Tanzania there is generally no shortage of labour. Job seekers will travel to any place that is accessible by means of transport. An important issue is however the availability

of accommodation and utilities such as housing, water, and medical facilities. In principle the surveyed area is easily accessible via public transport but would require dedicated transport services from residential areas to the factory. This service may be served by special bus operators at a cost.

Although the potential work force is large, the skills and knowledge of the potential workforce are likely insufficient for the specific operations in the factory. Project staff may need to be trained to achieve performance standards required to reduce accidents and low performance. The training of staff includes improvement of skills in handling certain complex equipment (reach stackers, gantry cranes, tractor trains) and in organization and operations planning. It is recommended to organize training programs and facilities during project commissioning stage.

4.6 Compensation and Resettlement

With regards to resettlement of both legal and illegal inhabitants of an area, the relevant law, regulations, acts, national and international standards are listed in Annex A and B. When the general rules for compensation are applied, the market value for property valuation of a structure will be applied normally ranges from USD 190 to 300 per m^2. These estimates are provided by the Dodoma City council based on an average sized house normally found in the semi-urban setting.

In terms of compensation, some local experts are of the opinion that when compensation is meant for project affected persons that have encroached on the project area, the rules and process for compensation are less stringent and the actual land and property estimates are not used. For valuation, the Land Law and regulations provide adequate norms which are in the range of USD 120 to 190 per m^2. Other experts claim that Project Affected Persons that have encroached on any developmental project, privately or publicly owned property are not entitled to any compensation at all.

However, prior to project construction phase, the Tanzania Investment Centre (TIC) will handle all compensation and resettlement issues in collaboration with other government ministries, departments and agencies.

4.7 Environmental aspects

The environmental analysis considers both the construction and operational phases. The Project is located in a rural area with scattered houses. The visit made by the Consultant to the area revealed that, there few inhabitants, little social and commercial activities located within the surveyed area. This reduces the task of resettlement and other statutory obligations if the project would be constructed in the surveyed site.

4.8 Construction phase

The construction phase includes, clearing of the site, construction of the factory and plant installation. The following environmental impacts can be expected:

Vegetation and habitat loss: The project will clear some trees shrubs and vegetation cover to pave way for construction activities. This will disturb the micro-organism of the area. The impact is short term and of low significance.

Noise and vibration: The heavy machinery (caterpillars and tractors) used during site clearance, compaction of land and earth works will lead to emissions of noise and vibration. The accumulated effects from various sources of noise and vibration can adversely affect the health and well being of workers, as well as humans and fauna in the proximity of the site.

Dust emission: During clearing of the land, large quantities of top soil have to be removed and be disposed at designated areas. Large quantities of sand quarry are required for levelling and other earth works. The activities will generate dust and debris hence increasing Suspended Particulate Matter (SPM) in the air causing discomfort to the workers and surrounding community.

Solid waste generation: The construction activities will generate solid wastes such as metals, torn packing materials such as cement bags, plastics, woods, cans, paper bags and glass.

Sewage disposal: During construction, vendors and migrant workers will flock to the area surrounding the project site. The essence of trading (vendor) activities in unplanned area may result in sewage pollution with disease causing pathogens for diarrhea, malaria etc.

Air pollution: A part of dust emission, degradation of air quality will also be caused by gaseous emission from diesel combustion during land clearing, construction and transportation of building materials.

Public health impact: The influx of migrant workers, vendors and service providers will increase the risk of communicable diseases such as typhoid, TB, HIV/AIDS etc.

4.9 Project impact assessment

The potential impacts of the proposed project were identified by superimposing project elements onto the existing social and environmental natural conditions. A Checklist (Table *5*) method was used to identify the impacts and recommended mitigation measures. Discussion and interactions were made with stakeholders on issues related to social and environmental impacts and the possible alternatives. The no project scenario was not favored by most of the respondent.

Table 5: Key issues and problems identified

No.	Questions social, economy, environmental and technical issues	Yes OR No	Which Characteristics of the Project Environment could be affected?	Is the effect likely to be significant?
	1. Will construction, operation or decommissioning of the Project involve actions which will cause physical changes in the locality (topography, land use, changes in waterbodies, etc.)?			
	For each environmental effect place, a cross (X) in one of the columns			
1.1	Permanent or temporary change in land use, land cover or topography including increases in intensity of land use?	Yes	There will be clearance of the vegetation and the overburden/ vegetable soil. Mining activities will lead to change the land used for agriculture.	Yes, major change in environment at extraction sites. There is a risk of increase d solid erosion and instability of land because the nature of area being hills.

1.2	Creation of new land uses?	Yes	Land for the industrial activities particular clay making, process	Yes: the changes of land in this place is permanent
1.3	Pre-construction investigations e.g. boreholes, soil testing?	Yes	Soils	
1.4	Construction works? And Demolition works?	Yes	Road construction, temporary camps, and construction the	
1.5	Temporary sites used for construction works or housing of construction workers?	Yes		Minimum
1.6	Above ground buildings, structures or earthworks including excavations?	Yes	Excavation of clay; could lead to land instability, erosion,	
1.7	Production and manufacturing processes?	Yes	Process of brick making-the process involved	Yes. Environment may become much nosier during manufacturing
1.8	Facilities for storage of goods or materials?	Yes	There will be clearance to get the storage site during construction and also, there will be the storage for the bricks	No
1.9	Facilities for treatment or disposal of solid wastes or liquid effluents?	Yes	Will involve construction of sanitation systems for waste water and for solid waste	no
1.10	New road, during construction or operation?	Yes	Clearance to get new roads	More dust generation and may cause increased accidents
1.11	New or diverted transmission lines or pipelines?	Yes	There is a need to new electricity line. Although the during n operation the production is planned for the use of natural gas	

1.12	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	Yes	Construction of water collection point (Impoundment). The project will take the advantage of the hills in the area to develop a dam like structure	Impact -affect the availability of water to the down stream farmers
1.13	Stream crossings?	Yes		The Bihawana hill might be affected
1.14	Abstraction or transfers of water from ground or surface waters?	Yes	Will use the underground water	Yes.
1.15	Changes in waterbodies or the land surface affecting drainage or run-off?	Yes	Will block some flow of water from hills, this will be collected for the use in the project	Yes, because it may affect the natural functioning of the ecosystem of that area.
1.16	Transport of personnel or materials for construction, operation or decommissioning?	Yes	Will use the laborers from Bihawana town whom will be transported on daily basis	no
1.17	Long term restoration works?	No	Restoration will be an ongoing activity	No
1.18	Ongoing activity during decommissioning which could have an impact on the environment?	No	Will ensure that all control measure is done to minimize the cost and time of decommission time.	-
1.19	Influx of people to an area in either temporarily or permanently?	Yes	Will employ about 200 people, also due to business activities an influx is expected to be high.	Yes. Most likely there wil increased incidences of HIV, AIDS, human traffic, sex harassment, child labor etc.
1.20	Loss of native species or genetic diversity?	No		

	2. Will construction or operation of the Project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply?			
2.1	Land especially undeveloped or agricultural land?	Yes	Will use about 900 ha, for mining activities, brick manufacturing, road construction etc.	Yes-major change to the farmers who are using the land for agriculture, people nearby.
2.2	Water?	Yes	Water use is estimated to be 1million cubic meter per day	Yes-pollution to the surface and groundwater
2.3	Minerals?	Yes	Clay	
2.4	Forests and timber?	Yes	During construction only	No
2.5	Energy including electricity and fuels?	Yes	Will use intensive amount of energy, for drying and the brick, temperature up to 1200 centigrade	
	3. Will the Project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?			
3.1	Will the project involve use of substances or materials which are hazardous or toxic to human health or the environment (flora, fauna, water supplies)?	No	-	-
3.3	Will the project result in changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)?	Yes	The water storage dam, might be Source of mosquito breeding area. Dust generation	Yes- may result to asthma and other lung diseases. Also increased incidences of malaria
3.4	Will the project affect the welfare of people e.g. by changing living conditions?	Yes	There is a promise of employment, improvement of nearby roads, schools, hospitals etc.	-
3.5	Are there especially vulnerable groups of people who could be affected by the project e.g. hospital patients, the elderly?	No		

4. Will the Project produce solid wastes during construction or operation or decommissioning?				
4.1	Spoil, overburden or mine wastes?	Yes.	Will have a n overburden removed to get the clay soil, and waste from the manufacturing activities	No. The soil will have returned back to other places for the nursery and tree planting program
	Municipal waste (household and or commercial wastes)?	Yes	Will be generated from household and from the cafeterias, shops etc	no
	Hazardous or toxic wastes (including radioactive wastes)?	No		
	Other industrial process wastes? Surplus product?	Yes	Some broken and rejected products might be subjected to waste	-
	Sewage sludge or other sludge from effluent treatment?	Yes	-waste water generated from household and from the plant	-
	Redundant machinery or equipment?	Yes	Some broken part of the machinery, pipes etc.	
5. Will the Project release pollutants or any hazardous, toxic or noxious substances to a i r?				
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources?	Yes	Emission from the trucks during the construction and during the operation of the plant (transporting the products)	Yes-there will be dust from the mining sites and road transportation
	Emissions from production processes?	Yes	Dust from clay soil preparation from the	
	Emissions from construction activities including plant and equipment?	Yes		
	Dust or odours from handling of materials including construction materials, sewage and waste?	Yes		

	Emissions from incineration of waste?	Yes		
	Emissions from burning of waste in open air (eg slash material, construction debris)?	Yes		
	Emissions from any other sources?			
6.	Will the Project cause noise and vibration or heat energy?			
6.1	From operation of equipment e.g. engines, ventilation plant, crushers?			
	From blasting or piling?	Yes		
	From construction or operational traffic?	Yes		
	From blasting or piling?	Yes		
	From construction or operational traffic?	Yes		
	From lighting or cooling systems?	No		
	From any other sources?			
7.	Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into sewers, surface waters, groundwater, coastal waters or the sea?			
7.1	From handling, storage, use or spillage of hazardous or toxic materials?	NO		
	From discharge of sewage or other effluents (whether treated or untreated) to water or the land?	Yes	Will cause deposition of pollutants emitted to air, onto the land or into water	Yes, may lead to acidicity due to oxidation of the sulfur and other Nox
8.	Will there be any risk of accidents during construction or operation of the Project which could affect human health or the environment?			
8.1	From explosions, spillages, fires etc from storage,	Yes	Firing of brick at high temperature	Yes, may incur more
	handling, use or production of hazardous or toxic substances?		Above 1000centigrade, may result to accident. Risk of gas explosion Accident by trucks and mining equipment	cost and loss of life to people

	From events beyond the limits of normal environmental protection eg failure of pollution control systems?	No	-	-
	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslip, etc.)?	-	-	-
	From any other causes?			
9. Will the Project result in social changes, for example, in demography, traditional lifestyles, employment?				
9.1	Changes in population size, age, structure, social groups etc.?	Yes	Will involve employment of people during construction. Number of youth in expected to increase because are source of man power. During operation influx of people will increase	Yes
	By resettlement of people or demolition of homes or communities or community facilities e.g. schools, hospitals, social facilities?	Yes	Few farmers will be relocated.	No
	By placing increased demands on local facilities or services e.g. housing, education, health?	Yes	Will need for re houses education and health for the new families related to the project.	No
	By creating jobs during construction or operation or causing the loss of jobs with effects on unemployment and the economy?	Yes	More job will be created. About 300 directly job is assured	Yes
	Any other causes?			

5.0 Methodology

Feasibility was undertaken through consultation with various relevant stakeholders, reviewing various document including a review of the study report by MacLeod/GST (1972), Clays in Tanganyika, Summary of the Geology of Tanzania, Economic Geology, GST; The Environmental Management Act Cap 191 of 2004 and Environmental Impact

Assessment and Audit Regulation of 2005 and other literature relevant to clay and geological issues were reviewed. Additional information to augment the data was acquired through field studies. To ensure that, potential stakeholders are informed about the project, a notification letter and invitation was sent to the Local government and district council, informing them about consultation meetings to be conducted in their areas. Public participation was done through consultation meeting with key decision makers in the district including representative of ward officials and sub-ward leaders. The major concerns raised by the public are presented in this report and will later be addressed at later stages of the project.

The methodology adopted for the study entailed:

- Identification of key informants (comprising government officials, professionals, community leaders, and CBO"s) and soliciting their views and comments;
- Identification of wards and sub-wards belonging in the project area (at later stage of the project detailed selection sampling will be done to adequately include all adult men, women, youth, teachers, traders, and local government leaders etc.
- Conducting preliminary meetings and interviews officials at Dodoma district council and other key stakeholders

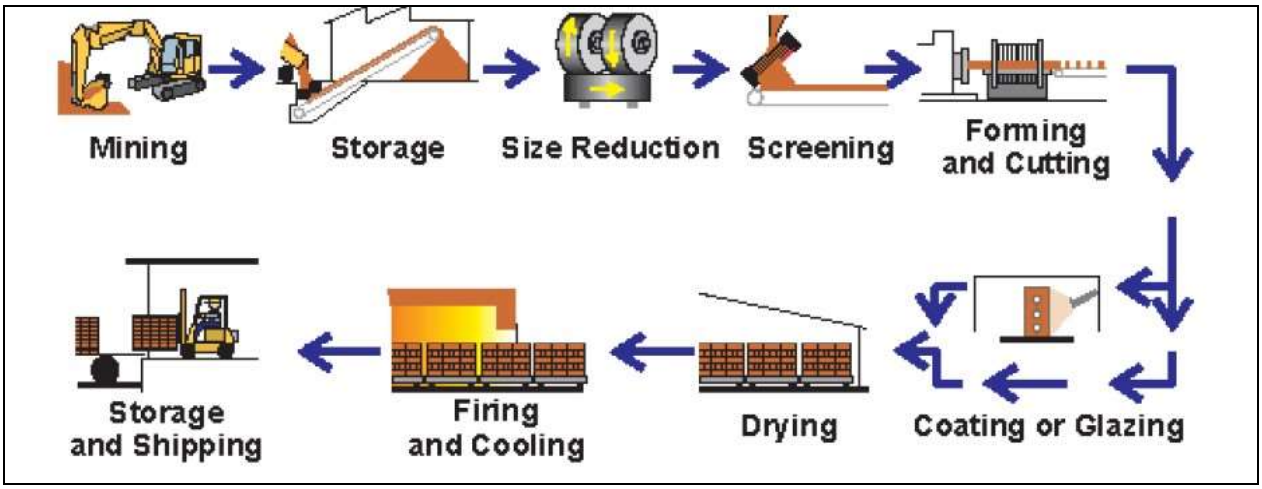
6.0 Technical Designs

6.1 Clay Brick Manufacturing Process

Clay bricks will be produced by mixing ground clay with water, forming the clay into the desired shape, drying and firing. The process summarized as follows:

- Mining and storage of raw materials,
- Preparing raw materials,
- Forming the brick,
- Drying,
- Firing and cooling and
- De-hacking and storing finished products

Figure 7: Clay Brick Manufacturing Process



Source: Clay Brick Association of Southern Africa, 2016

6.2 Clay Extraction

Clay is mined, mostly mechanically from an on-site but occasionally an off-site open cast mine. Clay mining is often confined to certain periods of the year when rainfall is low. Mined clay has an inherent moisture content and chemical and physical properties that differs from location to location.

6.3 Raw Material storage

Mined clay is stored for a period in large stock piles near the production plant. The purpose of stockpiling is to allow the clay to weather. Weathering ensures ease of milling later in the process, therefore helping to save energy. If sub-contracted mining equipment is utilised, storage also allows for the optimal use of mining equipment over shorter mining periods.

6.4 Clay Preparation

Weathered clay is milled in a crushing plant with the purpose of reducing the clay particles to the required size for brick production. Clay particle size has a direct correlation with the ability to later mold and shape the clay, as well as on the quality of the final product. Additions of dry fueling materials as internal body fuel such as fly ash or coal grains may be added during the clay preparation phase. Certain waste materials from waste-symbiosis programs may be added as additional body fuel, for material reduction or offering clay body enhancing characteristics. Mixing of various clays to

achieve specific colors is also completed in this phase, which may include the addition of chemicals and other additives to lower salinity or to increase plasticity.

Water, mostly from harvested water stored in the clay quarry, is also usually mixed in with the clay to increase the moisture content during this phase. This mix should then be stored in souring bins for a number of days. Souring ensures a homogenous mix improving the workability of the clay material, as well as providing a production buffer between the preparation and molding plants.

6.5 Molding

The molding phase, or better known as the extrusion phase, entails adding and mixing water in a mixer to achieve the final desired moisture content of the clay mix which is then passed through a pug-mill and de-airing chamber. This is to ensure that all the air entrapped within the clay body is removed.

The wet, de-aired clay mix is then extruded through a die into what is known as slugs which are then wire-cut into separate bricks, referred to as green bricks.

From here on forward in the production process, one would find either a highly mechanized and automated process in terms of brick handling, or a more labor-intensive process with little automation.

6.6 Drying

The cut bricks are then packed onto pallets, racks or direct set onto kiln cars which are transported to be dried in driers. Drying is either done naturally through solar and air drying (hack line drying), or through mechanical means in a tunnel or chamber dryer equipped with fans and utilizing heat energy recovered from the kiln.

6.7 Firing

Once the bricks have dried to a specified moisture content ready to be fired in a kiln. There are a number of different firing kiln technologies, i.e. clamp kilns, tunnel kilns, transverse arch kilns, Hoffman kilns, vertical shaft brick kilns and zigzag kilns. The basic purpose of a kiln is to fire the bricks into a vitrified state through the input of

energy from any added internal body fuel and external firing fuel, which may be coal particles, natural gas, oil or wood.

A firing cycle would include pre-heating, firing, soaking and cooling phases irrespective of the kiln type. In most cases, other than in clamp kilns, heat is recovered in the cooling phase for drying.

6.7 Packaging and Delivery

Final products are de-hacked and sorted onto pallets for sale. Mechanical off-packing is also used in the more technologically advanced manufacturing plants. Waste from the firing process varies for each firing methodology.

6.8 Utilization of clay resources

One of the aspects that contribute significantly to the sustainability of clay building materials is the abundance of the basic raw material, derived from shales or clays. To differentiate the commercial large-scale production of clay-based building materials from the small scale more informal production we need to consider the following two points. Firstly, small scale / informal production is mostly un-mechanized and producers therefore tend to congregate in river beds or water courses to enable access to "naturally" prepared materials and water for the hand molding of product. This results in potentially large scale and irreversible damage to water courses and river beds, or even loss of use of agricultural land. Secondly, a low-cost "informal" block production method such as the commercially available "Hydraform" block often utilizes agricultural soils that should be protected as national assets.

Commercial, mechanized operations would maximize the amount of material mined per square meter by allowing deeper mining. Topsoil and overburden may also be extracted and stored for later rehabilitation of the mining area back to agricultural land.

The implementation of mining best practices would facilitate the maximal use of available resources.

6.9 Application or resources available

Suitable clay reserves identified in the geological and mapping study and deemed accessible in terms of mineral and mining rights and in commercially viable locations

would be fully tested in laboratories. The chemical and physical analysis of the clay material would determine the expected ceramic properties, and guide the designing the

production processes, namely mining methodologies, clay preparation technologies, molding technology and process and product type feasibility, drying technology and firing technology as well as green product handling applications.

The results of the detailed clay analysis would guide the decision-making process in terms of the best fit technology and process design.

6.10 Sources of Fuel

The production process for clay building materials requires three primary energy input streams, namely electrical energy for driving machinery and fans, thermal energy for drying and firing usually coal, oil or gas and sometimes wood and diesel for motorized transport as in mining, moving of materials or product.

Typically, the energy split would be about 90% thermal energy for drying and firing and the 10% split for electricity and diesel. By reducing energy use through effective design, the application of best practice and effective energy management systems, it is possible to reduce energy bills, make the energy system more sustainable, and have a positive impact on greenhouse gas emissions. Commercially available and viable sources of fuel would be identified and assessed and considered in the technology and design decision making process. With energy costs accounting for between 40 and 60% of the production cost, each fuel source would need to be considered in the overall of each technology considered.

6.11 Firing Technology

Globally, there are internationally driven initiatives within the global clay brick sector to eliminate clamp-based firing, particularly because of poor working conditions and the inefficient use of carbon-based fuels leading to poor air quality, high CO_2 emissions and increased GHG emissions.

In considering suitable firing technologies, this project will therefore not consider clamp kilns, which in any case, provide a poor business case because of high waste, risk to weather and length of production cycle.

Intermittent kilns such as downdraught kilns could potentially be considered in small scale commercial production, although more efficient continuous fire kilns would be most suitable. Continuous fire kilns are either of the stationery fire (Tunnel or VSBK) or moving fire (Hoffman, TVA or Zig-Zag) variety. Below some of the technologies are described.

6.12 Production Technique

Labor Intensive

A key indicator for socio-economic sustainability is the level of employment opportunity. Cost effective and sustainable building materials should offer, especially when produced locally, direct as well as indirect employment. However, quality of job also needs to be considered, as well as the overall impact on cost to produce building materials and achieve a sustainable balance between cost of production and cost of product. Or, rather, is it better to stimulate construction jobs with higher skills levels or more production jobs but higher cost. The introduction of technology does not necessarily mean the introduction of automation. During initial stages of commercialization of clay brick production, a balanced mix between labor intensive and automation may be factored when full feasibility study will be conducted.

In the SADC region, most countries have a mix of labour intensive, highly automated and less automated clay brick production facilities. The Life Cycle Assessment (2017) shows that there are 4 jobs for every million bricks produced, including SMME suppliers to the sector.

Capital Intensive (Automation)

The converse of Labor Intensive is automation. The higher the level of automation the higher the capital cost. However, this capital cost needs to be balanced against input energy costs (energy efficiency), lower production waste, higher product yields, reduced labor costs, shorter production cycles (work in progress) and maintenance

costs. Good business cases with acceptable returns are achievable and would be covered by the technology feasibility study.

7.0 Financial Feasibility of the Project

7.1 Introduction

For the financial analysis, a financial model in Microsoft Excel was built to simulate the business case from the perspective of a future investment in building material industry for atleast certain period (base case: 8 years). This part introduces the financial model, provides a description of the assumptions underlying the model and presents the results of the analysis. Finally, recommendations will be made focusing on steps to be taken to take the project forward.

This section describes the financial analysis for the development of clay brick project. The financial analysis aims to provide insight in the financial feasibility of this development from the investment perspective of a developer of the project. It considers the project's ability to attract a private company (or consortium) to develop, maintain and operate the clay brick factory.

7.2 Financial feasibility

The financial analysis provides information about the financial feasibility of the project from the perspective of the owner. The main criteria to map out if the project is financially feasible are:

- The project Internal Rate of Return (IRR) is at least equal to the Weighted Average Cost of Capital (WACC). The reasoning and calculation of the WACC is illustrated in Annex C;

- The expected return on investors' equity corresponds with the characteristics and risks related to the projects. This is measured by the Return on Equity (RoE). The reasoning and calculation of the Return on Equity is also illustrated in Annex C;

- The project generates sufficient cash-flow to meet its financial obligations (interest payments and debt repayments). This is measured by the Debt Service Coverage Ratio (DSRC).

The financial analysis may result in calculation of the product selling price that the developers may apply in order to make the project commercially attractive.

7.3 Financial model

Objective

The objective of the model is to calculate the **financial** feasibility from the point of view of a project developer to:

- Develop/construct the clay factory including a necessary basic infrastructure for the factory;
- Maintain and operate the factory over a period of 25 years.

Assumptions

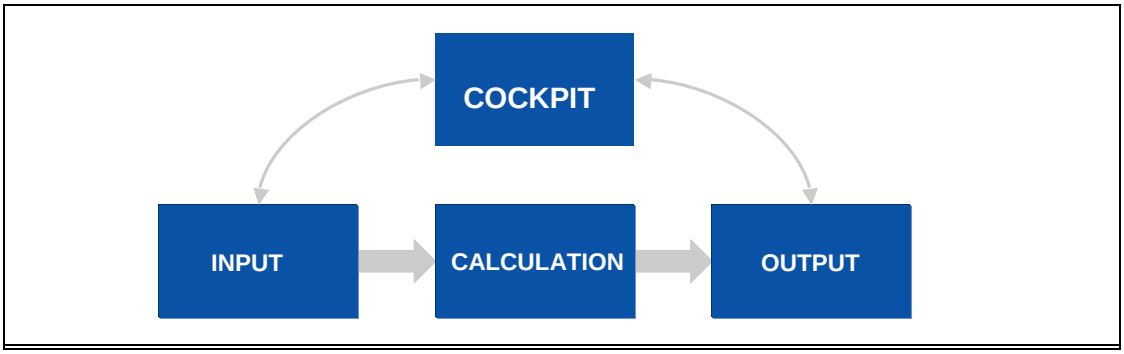
Assumptions made for the financial model are based on the:

- Design and cost calculations by the consultant;
- Analysis and research with respect to general, macro-economic and financial indicators relevant for this project;
- Communication with the client and other stakeholders. Based on a mission conducted in November 2017 an analysis has been drawn that describes the rationale for the proposed business model being the 'concession model' in case applies.

Structure

The model has been structured as per fig. 8 below

Figure 8: Structure of the Model



Source: GCG

The financial model makes it possible to easily assess the financial feasibility for different assumptions than estimated for the base case, for instance for 10% higher or lower investment and operational costs, price, timing and tax assumptions.

Input

The input part of the model consists of a worksheet presenting the assumptions taken into account in the model. The assumptions refer to aspects like timing, demand (revenues), costs, finance, returns (required) and taxes and will be further elaborated on in section 7.9 The input part of the model is the part that every other part of the model refers back to.

Calculation

The model uses the input to calculate all data needed to determine the output. The model contains calculations with respect to:

- The timing of the project (for instance the model indicates whether or not debt repayment has started, etc.);
- The total capital expenditures (CAPEX);
- The total operational expenditures (OPEX);
- The demand over the years and consequent revenue streams;
- The cash flows of the project over the years;

- The retained earnings of the project over the years;
- Finance in terms of debt, repayments, interest, equity, dividends etc;
- Tax regime;
- Relevant cover ratios (Debt Service Cover Ratio minimum/average).
- The effect of the risks and opportunities can be calculated as the cockpit makes it possible to immediately assess the influence on the financial feasibility when e.g. timing, expenditures or revenues assumptions change.

Output

The output sheets refer back to the calculation sheets. For this model the output consists out of:

- Cash flow statement;
- Profit and loss account;
- Balance sheet;
- Calculation of financial ratios.

Cockpit

The cockpit is constructed once the model is completed. It is the summary sheet of the model, showing the main results as well as the main drivers of the model. The drivers of the model can be changed in the cockpit, and the cockpit sheet will immediately show the results of such changes. This allows for the model to be easily optimized and scenarios to be assessed.

The cockpit for this project allows to assess the impact of different input (for timing, required return- and interest rates, finance, revenues and costs) on the:

- Return on equity generated (RoE);
- Internal rate of return (IRR);
- Annual- and minimum Debt Service Coverage Ratio (DSRC);
- Net present value (NPV).

Furthermore, as the financial analysis will be used to calculate the expected selling priceto make the project commercially attractive for private developers, the cockpit provides insight in the estimated price under different assumptions. This is done by

means of the 'goal seek' function. With this function the minimum price charged determines financial criteria applied (IRR, RoE, DSCR) to measure project performance.

Inflation

As this is a pre-feasibility study inflation is not taken into account. Moreover, the concession period is rather long (25 years). It is expected that potential investors will be highly reluctant to accept the risk on inflation over such a period. All numbers in this report are in real terms. It is noted that the financial model allows inflation to be incorporated. This makes it easier to build on the model in the next phases of project development.

7.4 Capital Expenditure

Cost estimates are made for the following items:

- Land and clay mining (purchase) of max 1,000 hectare (about 250 acres);
- Relocation and resettlement of persons and objects;
- Brick Firing system; (Tunnel Kiln model)
- Road infrastructure: connection to the main road (Mkonze - Iringa Road);
- Factory infrastructure (earth works, pavement, utilities, etc);
- Brick and tiles handling equipment (stackers, tractor trailers etc);
- Factory buildings, fences , etc;
- Furniture and fittings
- Motorvehicles
- Factory operations management system;
- Brick parking yard;
- Operating cost for the machines services (diesel, crew, track access etc);
- Operations and maintenance of factory infrastructure and office equipment.

The Consultants have based all development cost on their own knowledge. For certain items the assistance of stakeholders has been called in.

a) The Ward Executive Officer of Mbabala ward indicated that the cost of land is on average USD 1,000 per acre in Dodoma urban area. This figure has been used to estimate the cost of land for the project site.

b) Relocation and compensation costs are based on findings in section 4.6 being between USD 190-300 per m^2. The population density of Mbabala area is limited and for calculation purposes the consultants have assumed a total compensation of some USD 300,000.

7.5 Operational Expenditure

The operational costs are divided in two main categories, Direct operating expenditures and Indirect operating expenditures;

Direct and Indirect Operating Expenditures

These costs are calculated based on the growing need for the factory, for example staffing, repair and maintenance, utilities etc

7.6 Revenues

The revenues for the factory are calculated based on the selling price forecasts for bricks.

As the aim of the financial analysis is to calculate a price for which the project is feasible from the developer's perspective.

7.7 Cash flows

Assumptions with respect to days needed/allowed to collect revenues and to make payments are made. These are relevant for working capital calculations.

7.8 Finance

The main assumption is that finance (equity and debt) will be attracted to cover negative project cash flows.

The assumptions with respect to the expected returns that investors and banks will need to make to engage in the clay brick project are illustrated in Annex C.

The debt repayment period is minimized under the condition that the requirements for Debt Service Coverage Ratios (DSCR) are met using a Debt Sculpting Scheme in the financial model. As a minimum – by banks desired -DSCR of 1 is assumed this means that all Cash Flows Available for Debt Service (CFADS) are used for repayment of interest and debt. A grace period for interest repayments should be applied in the years

that interest that the payable interest is higher than CFADS because otherwise DSCR is not met.

7.9 VAT and Taxes

VAT is excluded from this financial analysis. The corporate tax rate for Tanzania is 30% and is included in the calculations.

7.10 Results of the Financial analysis

The main criteria to map out the project's financial feasibility are:

- Equity investors get a return that largely compensates for the project specifics and risks. This is measured by the Return on Equity (RoE). The first year calculated RoE for this project is 26.7% For detailed calculation of the RoE required see Annex C;
- The project Internal Rate of Return (IRR) is calculated. The IRR should be at least equal to the Weighted Average Cost of Capital (WACC). The calculated WACC for this project is 16% For detailed calculation of the WACC see Annex C;
- The project generates sufficient cash-flow to meet its financial obligations (interest payments and debt repayments). This is measured by the Debt Service Coverage Ratios (DSRC).

The financial analysis aims at providing estimates for the fee structure to be applied for which the project is expected to be commercially attractive for the private developer.

8.0 Conclusion and Recommendations

8.1 Conclusions

- The plan to establish clay brick factory in Dodoma was verified and compared in a multi-criteria analysis with other potential locations. The criterion of available space near to the sources of fuel and the market is considered of high importance in view of industrial and business development. Based on this assumption Dodoma was considered a preferential area.
- Of nearly five potential sites, Mbabala was considered the best site for clay brick factory due to it terrain structure which is much better geo-technically structured compared to other surveyed sites in Dodoma district. The planned industrial development area at Mbabala is attractive from a logistical point of view as well as terrain structure (narrowly shaped and hilly) point of view.
- The Mbabala site offers ample space for development for both clay mining and industrial activities.
- The financial feasibility of the project can be reached at a selling price that is competitive as compared to other building material, especially vibrated cement blocks.

8.2 Recommendations

Based on the above conclusions the consultants recommend to:

- Initiate and proceed with investigations (cadastral survey) on land ownership at Mbabala site to define the exact plots. At the same time District and Ward boundaries should be analysed as it may occur that (parts of) the plot are under Bahi District.
- Investigate further the geo-technical features of the site and the potential bottlenecks for development of the area. This should be done for the areas between Chididimo village and Zuzu Village;
- Execute an economic feasibility study (Project Profile Report) to assess the wider economic effects of the Clay brick project in view of securing loans from financial institutions.

- Review site geo-physical survey in more detail in view of local terrain conditions and track factory construction cost;
- Prepare the necessary legal and institutional concession framework for PPP after a full economic feasibility study has been undertaken.

Annexes

ANNEX A: Resettlement Legislation and Compensation

The legal and institutional framework for the resettlement and compensation of persons to be displaced in Tanzania contains the following Guidelines, Acts and Regulations.

1. Applicable Guidelines

The relevant national policies were briefly reviewed to provide guidance to the planning for the project. The Constitution of Tanzania defines the legal context in which all aspects of human development for Tanzanians, including land matters can operate. The Constitution is the dominant law of the land and defines land ownership in Tanzania by placing it under the custodianship of the President. Other matters follow from this main law as defined in specific locations. Overall, the law must ensure that project activities are undertaken in compliance with the policy requirements.

2. Land act No 4.1999

The Land Act (Section 156) requires that with regard to communal right of way in respect of way-leave, compensation shall be paid to any person for use of land, who is in lawful or actual occupation of that land, for any damage caused to crops or buildings and for the land and materials taken or used for the works. Requirements for the assessment of compensation are provided in the Land (Assessment of the Value of Land for Compensation) Regulations of 2001. The valuation of the affected properties must be done by a qualified and authorized valuator. Section 34 of that Act also states that where a right of occupancy includes land which is occupied by persons under customary law, and those persons are to be moved or relocated, they must be compensated for loss of interest in the land and for other losses. They also have the right to reap crops that are sown before any notice for vacating that land is given.

3. The Village Land Act No 5, 1999

The Village Land Act of 1999 confers the management and administration of village lands to Village Councils, under the approval of the Village Assemblies, although the Minister of Lands is entitled to decide on the amount of land which can be owned by a single person or commercial entity.

Any person who wrongfully obstructs or encroaches on the public right of way and who does not within the time specified in any notice served on him remove that obstruction or cease that encroachment commits an offence and upon conviction is liable to a fine.

4. Land Acquisition Act 1967

Under the Land Acquisition Act, 1967, the President may, subject to the provisions of this Act, acquire any land for any estate or term where such land is required for any public purpose.

Land shall be deemed to be acquired for a public purpose where it is required, for example, for exclusive Government use, for general public use, for any Government scheme, for the development of agricultural land or for the provision of sites for industrial, agricultural or commercial development, social services, or housing or; where the President is satisfied that a corporation requires any land for the purposes of construction of any work which in his opinion would be of public utility or in the public interest or in the interest of the national economy, he may, with the approval, to be signified by resolution of the National Assembly and by order published in the Gazette, declare the purpose for which such land is required to be a public purpose and upon such order being made such purpose shall be deemed to be a public purpose; or in connection with the laying out of any new city, municipality, township or minor settlement or the extension or improvement of any existing city, municipality, township or minor settlement; etc.

Upon such acquisition of any Land, the President is compelled on behalf of the Government to pay in respect thereof, out of moneys provided for the purpose by Parliament, such compensation, as may be agreed upon or determined in accordance with the provisions of the Land Acquisition Act, 1967.
The President may also revoke a right of occupancy if in his opinion it is in public interest to do so. Accordingly, the land for which a right of occupancy has been revoked reverts to the Government for re-allocation pursuant to the existing need(s). It should also be noted here that, though the land belong to the government some changes on the land act has taken place. Land has value to the owner; therefore, any land taken from the user has to be compensated. Based on this act the villagers affected by the project are claiming that they should be compensated for the lost farms and land used for residential purposes.

5. National Land Use Planning Commission Act 3/ 1984
The act established a National Land Use Commission (NLUC) as the principal advisory organ of the government on all matters related to land use. Among other things, it recommends measures to ensure that the government policies, including those for development and conservation of land, take adequate account of their effects on land use, seek the advancement of scientific knowledge of changes in land use and encourage development of technology to prevent, or minimize adverse effects that endanger human man's health and welfare. The act also specifies standards, norms and criteria for the protection of beneficial uses and the maintenance of the quality of the land.

6. The Grave Removal Act No 1968
Graveyard Removal Act of 1968 refers directly to grave removal and requirement for compensation. The act says the owners of graves should be compensated and the remains reburied else to pave way for development interventions.

7. The Land Assessment of the Value Compensation, Regulations 2001
These regulations provide criteria for the assessment of compensation on land, as per market value for real property; disturbance allowance is calculated as a percentage of market value of the acquired assets over twelve months; and transport allowance calculated at the cost of 12 tons hauled over a distance not exceeding 20 km. The other criteria includes loss of profit on accommodation based on business audited accounts and accommodation allowance equivalent to the rent of the acquired property per month over a 36 month period.

Regulations made under S 179, (the Land Assessment of the value of land for Compensation) Regulations, 2001 and which became operational in May 2001 provide assessment of compensation on land to be based on the following:

- Market value of the real property;
- Disturbance allowance which is a percentage of market value of the acquired over 12 months;
- Transport allowance calculated as the cost of 12 tons hauled over a distance not exceeding 20 km;
- Loss of profit or accommodation based on business audited accounts;
- Accommodation allowance which is equivalent to the rent of the acquired property per month over 36 month's period;
- Methodology of valuation of the lost assets, mode of payment, dispute resolution mechanisms;
- Agencies responsible for expropriation and implementing resettlement (including an assessment of their institutional capacity to conduct those activities);
- Gaps, if any, between national laws and other donor agencies and the mechanisms to bridge those gaps.

8. Involuntary Settlement (World Bank OP 4.12) 2001

The World Bank operational Policy on Involuntary resettlement acknowledges that development projects that displace people generally gives rise to economic, social and environmental problems. The Bank guidelines prescribe measures to minimize the negative impacts and ensure that the displaced community benefits from the project.

Therefore the policy requires that displaced people should be:

- Compensated for their losses at full replacement costs prior to the actual move;
- Assisted with the move and supported during the transition period in the resettlement site;
- Assisted in their effort to improve their former living standards, income earning capacity and production levels or at least restore them;
- Integrated socially and economically in the host communities so that adverse impacts in the hoist communities are minimized. The best way of achieving this integration is for resettlement to be planned through consultation involving affected people.

In addition, land, housing, infrastructure and other compensation should be provided to the adversely affected population, indigenous groups, ethnic minorities, and pastoral people who may have usufruct or customary rights to the land and other resources taken for the project. The absence of legal title to land by such groups should not be a bar to compensation.

The existing policies, land laws and regulations regarding land acquisition and compensation in Tanzania are consistent with the World Bank Operational Guidelines. Therefore, compensation issues could still be handled within the existing regulations without contradicting the World Bank Policy requirements. However, since the road construction works for this project will be confined within the existing right-of-way and no significant damage to properties will be expected from the rehabilitation works.

9. The National Land Policy 1995

The land policy stipulates that all land is public land, vested in the president as a trustee, and that this should be entrenched in the constitutions. The National Land Policy (1995) provides that a dual system of tenure, which recognizes both customary and statutory right of occupancy as being equal in law be established. The policy further establishes that the land has value, which right and interests of citizens in land shall not be taken without due process of law and that full, fair and prompt compensation shall be paid, when land is acquired. The compensation should be paid to any person whose right of occupancy or recognized long standing occupation or customary use of land is revoked or otherwise interfered with to their detriment by the State under the Land Act of 1999.

According to the policy, the administration of village land is vested in the village councils. Village councils have to consent before any alienation of village land is effected. In case of land allocations, village councils shall report to respective village assemblies. The land in the towns is governed the either by City, Municipal or Town Council.

In principle the Minister responsible for land matters is the sole authority in land issues. But the policy involves the public and private institutions whose functions are associated with lands i.e. local authorities, communities, non-governmental organizations and community based development organizations to participate and co-operate with the minister at different levels during the implementation of the policy and utilization of land.

To address the problem of multiple land allocation, and its resultant disputes, the Commissioner for Lands, is the delegated sole authority for administration of land. He may appoint officers to administer on behalf.

10. National Human Settlement Policy

Among others, the policy objectives that touch the road sector are to improve the level of the provision of infrastructure and social services for sustainable human settlements development and to make serviced land available for shelter and human settlements development in general to all sections of the communities. The infrastructure and services constitute the backbone of urban/rural economic activities. All weather roads, reliable and efficient transport system are essential to increase productivity and establishment of manufacturing industries. The policy promotes the development of human settlement that is sustainable. It also geared to improve the provision of infrastructure and social services for sustainable human settlement development.

ANNEX B: Valuation of Assets

1. Valuation of assets

The affected property needs to be inspected value provided. Objective of valuation of the properties will to determine replacement cost and market value for compensation purposes. Local government authorities informed local communities of the intended RAP activities and the possibility of relocating residents.

In carrying out field surveys the Valuer will at all times accompanied by a local leader i.e. Executive Officer (VEO) and or Village Chairperson who identified the property owners, confirm the boundaries shown by the owner and certified on the field sheets of the count of property.

In brief, the following will be done:

- Identification of assets affected by the project and their respective owners;
- Survey team also compiled a detailed inventory of the types, sizes and conditions of the land and assets of each affected households, business or entity and determined the value of compensation to be paid to each household for affected land, assets and loss of income sources;
- Assigning Reference Number to each of the identified case in a pink card;
- Taking notes of the identified properties (buildings) and other assets on a prepared inspection sheet;
- Taking measurements of the land and inspection of the buildings with help of the land surveying team;
- Ensuring that all entries on the inspection sheets are counter checked and signed by the local leaders and the property owners in the respective location results of survey and valuation exercise will be presented to Ministry of Land and Urban development in valuation report, therefore, provided the principal sources of information on the number and location of affected properties, the number and categories of the affected households, the nature and magnitudes of losses and displacement, the methods used for valuing land, assets and loss of income and assessing compensation and the amount of compensation to be paid.

2. Basis of Valuation

Valuation Methods to adopt was guided by provisions of the Land Act No. 4 of 1999 and financer terms of reference, e.g. The Replacement Cost Method and market valuer was used.

As indicated before, in valuing properties along the Songea-Namtumbo Road, the Replacement Cost Method of Valuation has been adopted, this method is sometimes known as the Contractors Test Method of Valuation. In this method, the value of an asset is determined by reference to the cost of replacing or reinstating it (as new) or that of its substitute. Where the asset/property is not new the replacement cost is then depreciated to derive at depreciated replacement cost which is equivalent to a market Value.

However, for the purpose of this exercise we have also adopted the MCC and World
Bank requirements as detailed in the Terms of Reference (ToR) that the compensation value is obtained from the Replacement Cost added with allowances. A rate of construction per meter square was obtained from the office of respective District Valuer. In the case of crops, a list of prices was obtained from Songea municipal council which was updated. Land measurements were in square meters.

3. Computation of the Various Allowances

Disturbance Allowance

Disturbance Allowance is payable as a percentage of real property value in compliance to the provisions of Act No. 4 of 1999. The percentage is the average commercial bank rates offered on fixed deposits. From data obtained from the various financial institutions in Tanzania the average rate on fixed deposits is 4% per annum.

Loss of profit

In accordance with section 9 of the 2001 Regulations of land act no. 4 of 1999 the net monthly profit obtained from the business associated with the affected properties is assessed (for high incomes), evidenced by audited accounts where necessary and applicable, and multiplied by 36 months in order to arrive at the loss of profit payable. This calculation applies also for such businesses that are only temporarily affected during the project's construction phase. In case PAP fail to produce the audited account, then there is no loss of profit can be paid.

Loss of accommodation

The Tanzanian law requires an accommodation allowance to be paid to the claimants to support them to afford to pay monthly market rent for an alternative accommodation during the period of constructing an alternative accommodation. In accordance with section 8 of the 2001 Regulations of Land Act 4 of 1999, accommodation allowance is calculated on the basis of monthly rent multiply by 36.

Replacement costs are categorized separately from houses, structures, crops and trees. Sites for relocation are to be identified. In most cases this will involve "stepping back" within the same plot, rather than total relocation. Assistance to vulnerable groups like aged people, widow, orphans, single mothers are provided form of assistance.

Additional to the above the affected people are required to be paid transport allowances as well as money to transport their luggage.

ANNEX C: Weighted Average Costs of Capital (WACC) Calculations

In view of implementing this project with the private sector, a key point of departure for this feasibility study is to assume that capital expenditures will be privately financed. Private capital providers will require a return on the capital provided to finance the investments. The required rate of return will reflect their perceived risk of the investment.

The required rate of return for capital providers is commonly referred to as Weighted Average Cost of Capital (WACC). The WACC is used to discount all cash flows over the lifecycle of the investment (e.g. incoming cash flows or revenues and outgoing cash flows such as capital and operational expenditures). The consequent net present value (NPV) of these cash flows is to be considered as the value of the project. A negative NPV implies that the project is not financially feasible (i.e. the cash flows are insufficient to provide the capital providers a fair rate of return).

Essentially there are 2 basic forms of capital; equity and debt.

- Debt is commonly provided through bank loans (alternatively through issuance of bonds). The cost of debt is reflected by the interest rate charged by banks. These interest expenses are tax deductible (i.e. operating income is reduced by interest expenses before the income or profit tax is calculated).
- Equity is provided by the shareholders. They are most at risk. Any incoming cash is first used to pay operational expenditures, service the debt and settle the tax liabilities. Any remaining cash can be distributed as dividend to the shareholders. If cash is insufficient, the paid-in capital from the shareholders will be used to meet the financial obligations. The required rate of return on equity will consequently be higher than the required rate of return on debt.

The WACC can be summarized as follows:

$$WACC = k_e \frac{E}{D+E} + k_d (1-t) \frac{D}{D+E}$$

t = corporate tax rate; D = debt; E = equity; k_e = cost of equity; k_d = cost of debt

It is to be noted that assessing a WACC is not an exact science. Although most practitioners agree on the principles of the methodology, it is subject to interpretation. These details aims to present a realistic cost of capital taking into account generally accepted principles and project specific characteristics. It will firstly address the cost of debt, secondly the cost of equity, thirdly the leverage being the ratio debt to equity followed by a concluding summary of the WACC.

Capital Structure

PPPs will be financed with equity and debt. Equity represents an ownership claim on the earnings and assets of a project. That is, after debt holders' claims are paid, the management of the company can either pay out the remaining earnings to equity holders (project sponsors) in the form of dividends, or reinvest the earnings back into the project.

For infrastructure projects sponsors can be both public and private. Typically, leverage (the proportion of debt in the total financing package) for infrastructure projects is high because debt is cheaper than equity. The reason for this is twofold:

- Debt providers have less risk than equity providers. Return on equity is based on dividends and capital gain (increase in value of the shares). Equity providers will receive dividends only after operating expenditures, debt service and taxes are paid. When income is insufficient they will not receive any dividend. As for capital gains this will depend on the ability to return dividends based on the future cash flows. This is uncertain and this risk will be priced accordingly by the equity providers;
- Interest costs are tax deductable. The net cost of interest to a company is equal to the interest payable minus the income tax percentage times the interest payable.

Having a proxy of the capital structure is essential in determining the cost of capital. It enables the weighing of the respective costs of acquiring debt and equity capital, combining them into a weighted average cost of capital. The contribution of debt financing vs. equity financing to the company's capital structure is also known as gearing, finance mix or leverage.

Based on international practices and taking into account the risk profile of the project and the current circumstances in the financial sector, debt to capital is proposed to be 70 percent and equity to capital is proposed to be 30 percent.

Cost of Debt

The cost of debt is the interest rate the project company (or special purpose vehicle will have to pay for its bank loans). Conventionally, the cost of debt is measured as the risk free rate plus the debt premium; the latter being obtained as the credit spread over the credit risk free security / reference rate:

$$k_d = r_f + \text{debt premium}$$

k_d = cost of debt r_f = risk free rate of return

To calculate the cost of debt for developing countries, the parameter country risk premium, which varies by the country's credit rating, is added to reflect the additional return required to invest in these inherently riskier countries. The equation becomes:[1]

$$k_d = [(1 + r_f) * (1 + CRM) - 1] + \text{debt premium}$$

k_d = cost of debt r_f = risk free rate of return

CRM = country risk premium

Accordingly, the cost of debt is a function of the risk free rate of return, the country risk premium, and the debt premium.

Risk free rate of return

The risk-free rate is a theoretical construct defined as the rate of interest that can be obtained by investing in financial instruments with no default risk. Since a truly risk-free asset does not exist in practice, the yield on long-term government securities is usually used as proxy for the risk free rate; US Treasury Bond rates are commonly chosen. These securities are considered to be risk-free because the likelihood of this government defaulting is extremely low.

In estimating the discount rate for Tanzania, the long-term yield on US Treasury Bonds, is regarded as the representative approximation of the risk free rate of return.

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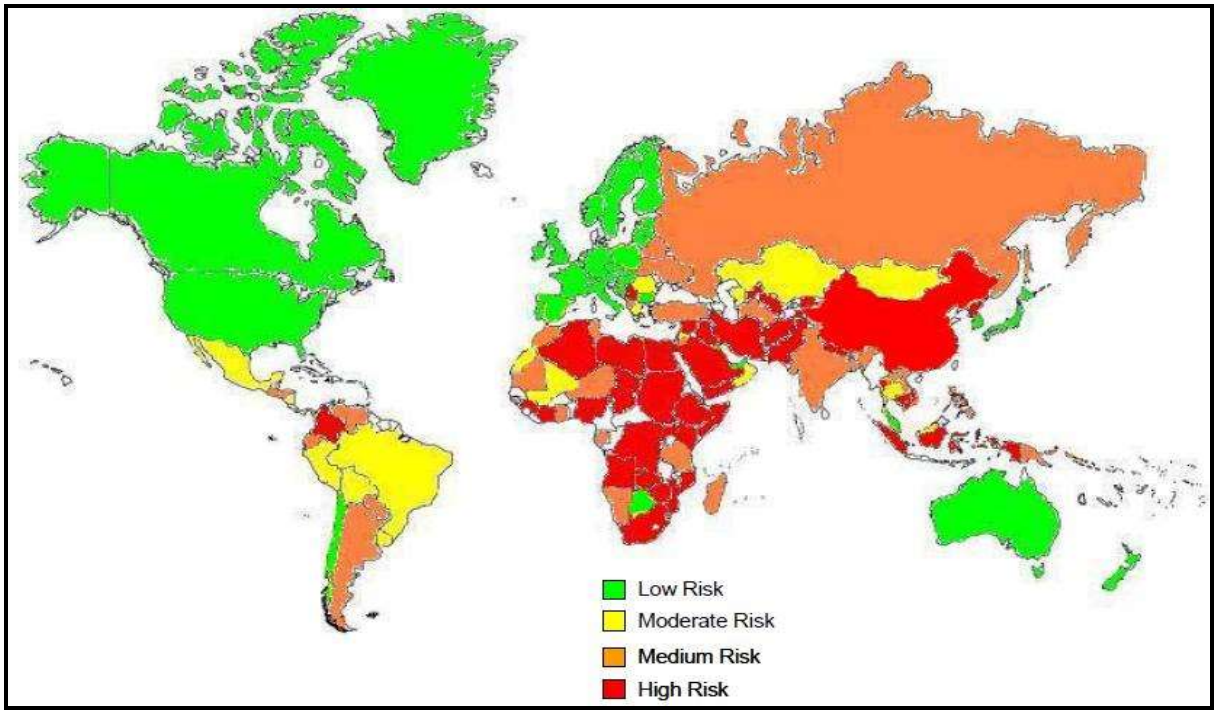
[1] The real cost of capital. Chapter 6: International WACC and country risk on http://www.costofcapital.net/Chapter6%20-%20Country%20Risk%20(25-07-04).doc [3] As published by the US Treasury Department.

Hence, the assumed risk free rate for a long term concession in Tanzania is 4,6%

Country risk premium

Normally the country risk premium is assessed by the credit rating agencies in relation to to a sovereign bond issuance of the respective country. Such a rating is not available for Tanzania.

In order to approximate the country risk premium for Tanzania, the country risk premium of countries with a comparable credit risk rating can be used. For this purpose two listings have been used:



Source: AON Risk map, 2014

- The AON Political & Economic Risk Map, This Map provides an indication of overall levels and types of Political Risk in more than 200 territories worldwide.

- OECD Country Risk rating . This rating is based the Country Risk Classification Method which measures the country credit risk, i.e. the likelihood that a country will service its external debt.

Based on these listings a peer group has been defined as countries that have a similar classification in both the AON and the OECD ranking as Tanzania. Of the resulting group of countries only a few have sovereign credit ratings from the major credit rating.

The average country risk premium of the peer group is 8%, which may be considered a fair proxy for country risk profile of Tanzania.

Debt premium

The debt premium consists partly of a compensation of the systematic risk (debt beta) that can be allocated to the funding on part of the lender. It forms a compensation for the possibility of default and is, hence, determined by the creditworthiness of the issuer. As the credit spread is directly related to the credit rating, the premium can be close to zero for organizations with a high credit rating. However, the spread can be substantial for organizations with a poor credit rating. The systematic risk for the debt providers is defined by the risk profile of the issuer or in case of project finance by the project. To

approximate the risk profile of the project, the credits rating of companies acting in comparable businesses have been used.

In order to assess an appropriate credit spread based on the credit ratings in the industry, the most recent credit spreads per rating category as set indicated by Standard& Poor's have been offset against the credit ratings in the industry.

Taxation

The cost of debt as described is measured in before-tax terms. However, because interest expense is deductible, the after-tax cost of debt should be used in calculating the discount rate. The after-tax cost can, simply, be obtained by multiplying the before-tax cost by one minus the corporate tax rate:

$$k_d (1 - t)$$

t = corporate tax rate k_d = cost of debt

The corporate tax rate for Tanzania is 30%.

Cost of Equity

The cost of equity is the minimum rate of return a company must offer shareholders as compensation for waiting for returns and for bearing risk. It reflects the shareholders' opportunity cost of investment. The required rate of return on equity can be approximated by the so-called Capital Asset Pricing Model (CAPM) as defined by Modigliani and Miller. CAPM is based on the following formula.

$$k_e = r_f + \beta_E x \text{ ERMP}$$

k_e = cost of equity r_f = risk free rate of return β_E = equity beta

ERMP = equity market risk premium (= $r_m - r_f$ = market rate of return – risk free rate of return)

Accordingly, the cost of equity is a function of the risk free rate (as described) and a risk premium. The core of the risk premium is the equity risk premium. The latter is a function of the market risk premium and a company's equity beta (β_E), which, in turn, is a function of both asset risk (β_A) and leverage.

The further substantiate the risk premium for equity providers the cost of equity also includes a country risk premium (as already described upon assessing the cost of debt) and a size premium.

The concept of a size premium is based on empirical evidence suggesting that smaller size companies are riskier and, therefore, should have a higher cost of equity. This phenomenon, that to some degree contradicts the CAPM, relies on the notion that smaller companies' risk is not entirely captured in their betas given limited trading volumes of their stocks, making covariance calculations incorrect.

The equation becomes:[2]

$$k_e = r_f + \beta_E x \text{ ERMP} + \text{CRP} + \text{SRP}$$

k_e = cost of equity r_f = risk free rate of return β_E = equity beta

ERMP = equity market risk premium (= $r_m - r_f$ = market rate of return– risk free rate of return)

CRM = country risk premium

[2] The real cost of capital. Chapter 6: International WACC and country risk on http://www.costofcapital.net/Chapter6%20-%20Country%20Risk%20(25-07-04).doc

Equity market risk premium

The equity market risk premium (EMRP) reflects the return that must be provided over and above the risk free rate to compensate equity suppliers for bearing market risk (i.e. systematic risk). In other words, it is the difference between the risk-free rate and the stock market rate. The EMRP derives from the volatility in the stock market, measured as the standard deviation.

The global EMRP is, in accordance with long term expectations,[3] set to 4.%.

Systematic risk

Unsystematic risk affects a very specific group of securities or assets or even an individual security or asset; can be eliminated by holding a diversified portfolio; and is also know as "idiosyncratic risk" or "diversifiable risk". Because this risk can be diversified away, it is not priced in the market (i.e. investors do not receive compensation for bearing it).
Systematic risk affects a broad range of securities and assets; refers to the movement of the entire economy; cannot be avoided by diversification; and is, as such, also known as "market risk" or "un-diversifiable risk". Because this risk cannot be diversified away, it is priced in the market (i.e. investors receive a premium for bearing it). Systematic risk is not the same for all securities or assets though, different companies respond differently to, for instance, a recession.

An often-used measure of the sensitivity of a stock or asset to systematic risk is the equity beta (β_E). For a publicly traded company, β_E is measured by regressing its historical returns (i.e. movements of its share price) on stock market index historical returns (representing for market movements). The slope of the resulting regression line is the beta.

For a company that is not publicly traded, however, only an approximate beta can be obtained, by relying on information from publicly listed peers. Rather than simply averaging the equity betas of the peer companies, the following steps are taken:

- Selection of peer group companies;
- Calculation of each peer company's asset beta (β_A) by unlevering its equity beta;
- Using either the average or the median value of the unlevered betas of the peer companies to obtain an estimate of the industry asset beta;
- Re-levering the industry asset beta to account for capital structure.

The logic of this procedure is as follows. Companies that compete in the same industry are expected to face similar business risks. However, given that most firms are levered, the estimates of equity betas that are publicly available reflect the combined effects of business risk and financial risk. Asset betas only reflect the business risk, which is expected to be common to all companies in the industry. So, when using information on betas from a peer group, the business risk should be separated from the financial risk, which will be specific to each company given its financial leverage. This can be done by converting the equity betas (levered betas) into asset betas (unlevered betas) through the following equation:

$$\beta_E = \beta_A [1 + (1-T) (D/E)]$$

t = corporate tax rate D/E = debt-equity ratio β_E = equity beta β_A = asset beta

[3] In accordance with finance expert Prof. Damoadaran (NYU) who states the expectation that 'risk premiums will revert back to lower values (4 to 4.5 percent) in the long term'. - http://pages.stern.nyu.edu/~adamodar/

Build Africa Holdings Limited							**Annex 1(a)**
Clay - Kaoline Bricks Manufacturing Project							
TZS/USD Exchang rate							
BoT (02.05.2018)					2,180		
Investment Capital Items Cost Estimates (ICICE)							

Investment Capital Items Cost Estimates (ICICE)									Annex 1 (b)
7. Pre-Operating Expenses (POE)									**Total Cost: USD**
7.1 Initial Project costs									
Such as: (i) Reports - (a) ESIA and (b) Feasibility study; and (ii) Village land compensation									300,000
7.2 Fund mobilisation									
Assumption: Loan amount as a % of FICICE					USD	32,168,000			
(a) Facility fees - as a % of loan amount						0.50%			160,840
(b) Legal fees - as a % of loan amount						0.50%			160,840
(c) Fund mobilisation fees (Success fee) - as % of loan amount						0.50%			160,840
7.3 Loan Interest During Project's Physical Implementation (LIDPPI)									
Assumptions:									
(a) Project physical implementation period is 1 year (12 months)									
(b) Interest on Loan p.a.									10.00%
(c) Loan is disbursed at beginning of each month during project's physical implementation as under:									
No. of Loan disbursements	**Month of Disbursement - DPPI**	**Purpose of loan disbursement**	**% age of loan disbursed**	**Loan amount disbursed**	**Loan Interest During Physicl Project Implementation (LIDPPI)**				**Total LIDPPI**
1	1	Bld constn	88.10%	28,339,018	236,158				236,158
2	2	P&E order	3.95%	1,270,144	236,158	10,585			246,743
	3				236,158	10,585			246,743
	4				236,158	10,585			246,743
	5				236,158	10,585			246,743
	6				236,158	10,585			246,743
3	7	P&E shipt	7.63%	2,455,138	236,158	10,585	20,459		267,203
	8				236,158	10,585	20,459		267,203
	9				236,158	10,585	20,459		267,203
4	10	Te RAT+DSA	0.53%	170,000	236,158	10,585	20,459	1,417	268,619
	11				236,158	10,585	20,459	1,417	268,619
	12				236,158	10,585	20,459	1,417	268,619
		Total	100.21%	**32,234,300**	**2,833,902**	**116,430**	**122,757**	**4,250**	**3,077,339**
5.4 Project Management fees as a % of FICICE							0.50%		51,540
Total: Pre-Operating Expenses									**3,911,399**

Capital Investment Items Cost Estimates (CIICE)			Annex 1 (c)
Summary of Capital Investment Items Cost Estimates			**Total Cost: USD**
(1) Investment Capital Items			
Land and clay pits			1,700,000
Buildings			7,358,009
Plant and equipment			37,774,463
Office equipment			480,043
Furniture and fittings			480,043
Motor vehicles			480,043
Pre-Operating Expenses			3,911,399
Sub Total			**52,184,000**
Add:			
(2) Initial Working Capital			
Initial working capital			**1,429,378**
Total: Capital Investment Items Cost Estimates			**53,613,378**
Proposed Financing plan			
Type of funds	**Funding Proportion-%**	**Weighted Average Cost of Capital (WACC)**	**Total Cost: USD**
Equity	40.00%	10.00%	21,445,378
Loan	60.00%	6.00%	32,168,000
Total	100.00%	**16.00%**	**53,613,378**

Build Africa Holdings Limited										**Annex 2**
Clay - Kaoline Bricks Manufacturing Project										
Revenue assumptions										
1. Products										
(a) Product/Typpe of bricks			Hollow							
(b)Dimensions of bricks - All in mm:	Length	Width	Height	Weight-kg						
	420	330	60	4.5						
2. Production capacity										
2.1 Working days per annum				300						
2.2 Plant capacity utilization (PCU)										
(a) Rated Machine production capacity - no. of bricks per day				1,000,000						
(b)PCU for Year 1				80%						
(c) Compound Annual Growth Rate (CAGR) of PCU from year 1 to 3:				10.00%						
(d) From year 3 to year 8 PCU remains constant										
Year			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
3. Number of bricks produced annually										
(a) Production capacity utilization			80.00%	88.00%	96.80%	96.80%	96.80%	96.80%	96.80%	96.80%
(b)Number of bricks produced annually		Pcs: '000'	240,000	264,000	290,400	290,400	290,400	290,400	290,400	290,400
4. Annual revenues										
4.1 Inflationary index										
Annual inflation		2.00%								
Inflationary index			1.00	1.02	1.04	1.06	1.08	1.10	1.13	1.15
4.2 Selling price per brick	USD	0.24								
Annual Sales Revenue from sale of bricks		**USD:**	**57,247,706**	**64,231,927**	**72,068,222**	**73,509,586**	**74,979,778**	**76,479,373**	**78,008,961**	**79,569,140**

Build Africa Holdings Limited													**Annex 3 (a)**
Clay - Kaoline Bricks Manufacturing Project													
Operating cost assumptions													
Year						**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Inflationary index													
Annual inflation				2.00%									
Inflationary index						1.00	1.02	1.04	1.06	1.08	1.10	1.13	1.15
2. Total number of bricks produced annually				Pcs: '000'		240,000	264,000	290,400	290,400	290,400	290,400	290,400	290,400
3. Direct operating costs (DOC)		**Qty/brick**	**Cost/4.5 kg brick: USD**										
Clay @ kg		4.50	0.03		USD:	7,200,000	8,078,400	9,063,965	9,245,244	9,430,149	9,618,752	9,811,127	10,007,350
Gas @ m^3		0.000100	0.0000108		USD:	2,592	2,908	3,263	3,328	3,395	3,463	3,532	3,603
Water @ m^3		0.0005	0.0001996		USD:	47,898	53,742	60,298	61,504	62,734	63,989	65,269	66,574
Electricity @ kwh		0.1400	0.006		USD:	1,328,400	1,490,465	1,672,302	1,705,748	1,739,862	1,774,660	1,810,153	1,846,356
Labour		0.0012	0.006		USD:	1,328,400	1,490,465	1,672,302	1,705,748	1,739,862	1,774,660	1,810,153	1,846,356
Others		0.0133	0.06		USD:	14,400,000	16,156,800	18,127,930	18,490,488	18,860,298	19,237,504	19,622,254	20,014,699
Total					**USD:**	**24,307,290**	**27,272,780**	**30,600,059**	**31,212,060**	**31,836,301**	**32,473,027**	**33,122,488**	**33,784,937**
4. Indirect operating expenses			**As a % of Revenue**										
Administration			18.00%		USD:	10,304,587	11,561,747	12,972,280	13,231,725	13,496,360	13,766,287	14,041,613	14,322,445
Utilities-other than that of manufacturing			1.50%		USD:	858,716	963,479	1,081,023	1,102,644	1,124,697	1,147,191	1,170,134	1,193,537
Marketing			1.25%		USD:	715,596	802,899	900,853	918,870	937,247	955,992	975,112	994,614
Repair and maintenance - Non-Manufg			1.00%		USD:	572,477	642,319	720,682	735,096	749,798	764,794	780,090	795,691
Financial - other than that of loan interest			0.25%		USD:	143,119	160,580	180,171	183,774	187,449	191,198	195,022	198,923
Total			**22.00%**		**USD:**	**12,594,495**	**14,131,024**	**15,855,009**	**16,172,109**	**16,495,551**	**16,825,462**	**17,161,971**	**17,505,211**
5. Working capital schedule													**USD**
Item	**Basis**		**Period**	**Number**									
Stocks													
Raw materials	Cost of Clay/Kaolin		Month	0.25		-	-	-	-	-	-	-	-
Work in progress	DOC		Month	0.25		506,402	568,183	637,501	650,251	663,256	676,521	690,052	703,853
Finished goods	DOC		Month	0.5		1,012,804	1,136,366	1,275,002	1,300,502	1,326,513	1,353,043	1,380,104	1,407,706
Packing materials	DOC - Others		Month	0.5		600,000	673,200	755,330	770,437	785,846	801,563	817,594	833,946
Total						2,119,206	2,377,749	2,667,834	2,721,191	2,775,615	2,831,127	2,887,749	2,945,504
Debtors	Sales Revenues		Month	0.5		2,385,321	2,676,330	3,002,843	3,062,899	3,124,157	3,186,641	3,250,373	3,315,381
Total Stocks and Debtors						**4,504,527**	**5,054,079**	**5,670,677**	**5,784,090**	**5,899,772**	**6,017,767**	**6,138,123**	**6,260,885**
Less: Creditors													
Direct operating costs			Month	1		2,025,608	2,272,732	2,550,005	2,601,005	2,653,025	2,706,086	2,760,207	2,815,411
Indirect operating costs			Month	1		1,049,541	1,177,585	1,321,251	1,347,676	1,374,629	1,402,122	1,430,164	1,458,768
Total						**3,075,149**	**3,450,317**	**3,871,256**	**3,948,681**	**4,027,654**	**4,108,207**	**4,190,372**	**4,274,179**
Working capital						**1,429,378**	**1,603,762**	**1,799,421**	**1,835,409**	**1,872,118**	**1,909,560**	**1,947,751**	**1,986,706**
Change in Working capital						**1,429,378**	**174,384**	**195,659**	**35,988**	**36,708**	**37,442**	**38,191**	**38,955**

Operating cost assumptions										Annex 3 (b)
Year	1	2	3	4	5	6	7	8		
6. Depreciation schedule										**USD**
Gross Fixed Assets										
Land	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000		
Buildings	7,358,009	7,358,009	7,358,009	7,358,009	7,358,009	7,358,009	7,358,009	7,358,009		
Plant and equipment	37,774,463	37,774,463	37,774,463	37,774,463	37,774,463	37,774,463	37,774,463	37,774,463		
Office equipment	480,043	480,043	480,043	480,043	480,043	480,043	480,043	480,043		
Furniture and fittings	480,043	480,043	480,043	480,043	480,043	480,043	480,043	480,043		
Motor vehicles	480,043	480,043	480,043	989,468	989,468	989,468	989,468	989,468		
Pre-Operating Expenses	3,911,399	3,911,399	3,911,399	3,911,399	3,911,399	3,911,399	3,911,399	3,911,399		
Total	**52,184,000**	**52,184,000**	**52,184,000**	**52,693,425**	**52,693,425**	**52,693,425**	**52,693,425**	**52,693,425**		
Annual Depreciation	**Method**	**Rate - %**								
Land	Straight line	0.00%	-	-	-	-	-	-	-	-
Buildings	Straight line	4.00%	294,320	294,320	294,320	294,320	294,320	294,320	294,320	294,320
Plant and equipment	Straight line	12.50%	4,721,808	4,721,808	4,721,808	4,721,808	4,721,808	4,721,808	4,721,808	4,721,808
Office equipment	Straight line	12.50%	60,005	60,005	60,005	60,005	60,005	60,005	60,005	60,005
Furniture and fittings	Straight line	12.50%	60,005	60,005	60,005	60,005	60,005	60,005	60,005	60,005
Motor vehicles	Straight line	25.00%	120,011	120,011	120,011	120,011	127,356	127,356	127,356	127,356
Pre-Operating Expenses	Straight line	20.00%	782,280	782,280	782,280	782,280	782,280	-	-	-
Total			**6,038,429**	**6,038,429**	**6,038,429**	**6,038,429**	**6,045,775**	**5,263,495**	**5,263,495**	**5,263,495**
Accumulated Depreciation										
Land			-	-	-	-	-	-	-	-
Buildings			294,320	588,641	882,961	1,177,281	1,471,602	1,765,922	2,060,243	2,354,563
Plant and equipment			4,721,808	9,443,616	14,165,424	18,887,231	23,609,039	28,330,847	33,052,655	37,774,463
Office equipment			60,005	120,011	180,016	240,021	300,027	360,032	420,038	480,043
Furniture and fittings			60,005	120,011	180,016	240,021	300,027	360,032	420,038	480,043
Motor vehicles			120,011	240,021	360,032	480,043	607,399	734,756	862,112	989,468
Pre-Operating Expenses			782,280	1,564,560	2,346,839	3,129,119	3,911,399	3,911,399	3,911,399	3,911,399
Total			**6,038,429**	**12,076,859**	**18,115,288**	**24,153,718**	**30,199,493**	**35,462,988**	**40,726,484**	**45,989,979**
Net Fixed Assets										
Land			1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000	1,700,000
Buildings			7,063,689	6,769,369	6,475,048	6,180,728	5,886,407	5,592,087	5,297,767	5,003,446
Plant and equipment			33,052,655	28,330,847	23,609,039	18,887,231	14,165,424	9,443,616	4,721,808	-
Office equipment			420,038	360,032	300,027	240,021	180,016	120,011	60,005	-
Furniture and fittings			420,038	360,032	300,027	240,021	180,016	120,011	60,005	-
Motor vehicles			360,032	240,021	120,011	509,425	382,069	254,713	127,356	-
Pre-Operating Expenses			3,129,119	2,346,839	1,564,560	782,280	-	-	-	-
Total			**46,145,571**	**40,107,141**	**34,068,712**	**28,539,707**	**22,493,932**	**17,230,437**	**11,966,942**	**6,703,446**
Re-investments										
Motor vehicles						509,425				
Total						**509,425**				

Build Africa Holdings Limited									**Annex 4 (a)**
Clay - Kaoline Bricks Manufacturing Project									
Loan Terms									
(a) Loan amount								USD	32,168,000
(b) Rate of interest per annum									10.00%
(c) Monthly loan interest rate									0.83%
(d) Duration of loan - Months									96
(e) Loan is first disbursed at beginning of first month of physical implementation of project.									
(f) Grace period - 18 months from date of 1st loan disbursement									
(g) Loan Repayment on annuity basis - monthly in arrears - w.e.f. end the sixth month of operations									
(h) No. of loan repayment instalments									78
(i) Loan Repayment schedule is:									**USD**
Year	**Month**	**Loan principal o/s at beg of month**	**Loan princ o/s during the month**	**Monthly Loan instalment payable**	**Monthly Loan interest payable**	**Monthly Loan principal payable**	**Loan principal o/s at month end**	**Annual loan interest payable**	**Annual loan principal payable**
1	1	32,168,000	32,168,000	562,520	268,067	-	32,168,000		
	2	32,168,000	32,168,000	562,520	268,067	-	32,168,000		
	3	32,168,000	32,168,000	562,520	268,067	-	32,168,000		
	4	32,168,000	32,168,000	562,520	268,067	-	32,168,000		
	5	32,168,000	32,168,000	562,520	268,067	-	32,168,000		
	6	32,168,000	32,168,000	562,520	268,067	294,453	31,873,547		
	7	31,873,547	31,873,547	562,520	265,613	296,907	31,576,640		
	8	31,576,640	31,576,640	562,520	263,139	299,381	31,277,259		
	9	31,277,259	31,277,259	562,520	260,644	301,876	30,975,383		
	10	30,975,383	30,975,383	562,520	258,128	304,392	30,670,992		
	11	30,670,992	30,670,992	562,520	255,592	306,928	30,364,064		
	12	30,364,064	30,364,064	562,520	253,034	309,486	30,054,578	3,164,549	2,113,422
2	13	30,054,578	30,054,578	562,520	250,455	312,065	29,742,513		
	14	29,742,513	29,742,513	562,520	247,854	314,665	29,427,847		
	15	29,427,847	29,427,847	562,520	245,232	317,288	29,110,560		
	16	29,110,560	29,110,560	562,520	242,588	319,932	28,790,628		
	17	28,790,628	28,790,628	562,520	239,922	322,598	28,468,030		
	18	28,468,030	28,468,030	562,520	237,234	325,286	28,142,744		
	19	28,142,744	28,142,744	562,520	234,523	327,997	27,814,747		
	20	27,814,747	27,814,747	562,520	231,790	330,730	27,484,017		
	21	27,484,017	27,484,017	562,520	229,033	333,486	27,150,531		
	22	27,150,531	27,150,531	562,520	226,254	336,265	26,814,265		
	23	26,814,265	26,814,265	562,520	223,452	339,068	26,475,198		
	24	26,475,198	26,475,198	562,520	220,627	341,893	26,133,305	2,828,964	3,921,273

									Annex 4 (b)
(i) Loan Repayment schedule is:									**USD**
Year	**Month**	**Loan principal o/s at beg of month**	**Loan princ o/s during the month**	**Monthly Loan instalment payable**	**Monthly Loan interest payable**	**Monthly Loan principal payable**	**Loan principal o/s at month end**	**Annual loan interest payable**	**Annual loan principal payable**
3	25	26,133,305	26,133,305	562,520	217,778	344,742	25,788,563		
	26	25,788,563	25,788,563	562,520	214,905	347,615	25,440,948		
	27	25,440,948	25,440,948	562,520	212,008	350,512	25,090,436		
	28	25,090,436	25,090,436	562,520	209,087	353,433	24,737,003		
	29	24,737,003	24,737,003	562,520	206,142	356,378	24,380,625		
	30	24,380,625	24,380,625	562,520	203,172	359,348	24,021,277		
	31	24,021,277	24,021,277	562,520	200,177	362,342	23,658,935		
	32	23,658,935	23,658,935	562,520	197,158	365,362	23,293,573		
	33	23,293,573	23,293,573	562,520	194,113	368,407	22,925,166		
	34	22,925,166	22,925,166	562,520	191,043	371,477	22,553,690		
	35	22,553,690	22,553,690	562,520	187,947	374,572	22,179,117		
	36	22,179,117	22,179,117	562,520	184,826	377,694	21,801,424	2,418,355	4,331,881
4	37	21,801,424	21,801,424	562,520	181,679	380,841	21,420,582		
	38	21,420,582	21,420,582	562,520	178,505	384,015	21,036,568		
	39	21,036,568	21,036,568	562,520	175,305	387,215	20,649,353		
	40	20,649,353	20,649,353	562,520	172,078	390,442	20,258,911		
	41	20,258,911	20,258,911	562,520	168,824	393,695	19,865,215		
	42	19,865,215	19,865,215	562,520	165,543	396,976	19,468,239		
	43	19,468,239	19,468,239	562,520	162,235	400,284	19,067,955		
	44	19,067,955	19,067,955	562,520	158,900	403,620	18,664,335		
	45	18,664,335	18,664,335	562,520	155,536	406,984	18,257,351		
	46	18,257,351	18,257,351	562,520	152,145	410,375	17,846,976		
	47	17,846,976	17,846,976	562,520	148,725	413,795	17,433,181		
	48	17,433,181	17,433,181	562,520	145,277	417,243	17,015,938	1,964,751	4,785,486

									Annex 4 (c)
(i) Loan Repayment schedule is:									**USD**
Year	**Month**	**Loan principal o/s at beg of month**	**Loan princ o/s during the month**	**Monthly Loan instalment payable**	**Monthly Loan interest payable**	**Monthly Loan principal payable**	**Loan principal o/s at month end**	**Annual loan interest payable**	**Annual loan principal payable**
5	49	17,015,938	17,015,938	562,520	141,799	420,720	16,595,218		
	50	16,595,218	16,595,218	562,520	138,293	424,226	16,170,991		
	51	16,170,991	16,170,991	562,520	134,758	427,761	15,743,230		
	52	15,743,230	15,743,230	562,520	131,194	431,326	15,311,904		
	53	15,311,904	15,311,904	562,520	127,599	434,921	14,876,983		
	54	14,876,983	14,876,983	562,520	123,975	438,545	14,438,438		
	55	14,438,438	14,438,438	562,520	120,320	442,199	13,996,239		
	56	13,996,239	13,996,239	562,520	116,635	445,884	13,550,355		
	57	13,550,355	13,550,355	562,520	112,920	449,600	13,100,755		
	58	13,100,755	13,100,755	562,520	109,173	453,347	12,647,408		
	59	12,647,408	12,647,408	562,520	105,395	457,125	12,190,283		
	60	12,190,283	12,190,283	562,520	101,586	460,934	11,729,349	1,463,648	5,286,589
	61	11,729,349	11,729,349	562,520	97,745	464,775	11,264,574		
	62	11,264,574	11,264,574	562,520	93,871	468,648	10,795,926		
	63	10,795,926	10,795,926	562,520	89,966	472,554	10,323,372		
	64	10,323,372	10,323,372	562,520	86,028	476,492	9,846,880		
	65	9,846,880	9,846,880	562,520	82,057	480,462	9,366,418		
	66	9,366,418	9,366,418	562,520	78,053	484,466	8,881,952		
	67	8,881,952	8,881,952	562,520	74,016	488,503	8,393,448		
	68	8,393,448	8,393,448	562,520	69,945	492,574	7,900,874		
	69	7,900,874	7,900,874	562,520	65,841	496,679	7,404,195		
	70	7,404,195	7,404,195	562,520	61,702	500,818	6,903,377		
	71	6,903,377	6,903,377	562,520	57,528	504,992	6,398,385		
	72	6,398,385	6,398,385	562,520	53,320	509,200	5,889,185	910,073	5,840,164
7	73	5,889,185	5,889,185	562,520	49,077	513,443	5,375,742		
	74	5,375,742	5,375,742	562,520	44,798	517,722	4,858,020		
	75	4,858,020	4,858,020	562,520	40,484	522,036	4,335,984		
	76	4,335,984	4,335,984	562,520	36,133	526,387	3,809,598		
	77	3,809,598	3,809,598	562,520	31,747	530,773	3,278,825		
	78	3,278,825	3,278,825	562,520	27,324	535,196	2,743,628		
	79	2,743,628	2,743,628	562,520	22,864	539,656	2,203,972		
	80	2,203,972	2,203,972	562,520	18,366	544,153	1,659,819		
	81	1,659,819	1,659,819	562,520	13,832	548,688	1,111,131		
	82	1,111,131	1,111,131	562,520	9,259	553,260	557,871		
	83	557,871	557,871	562,520	4,649	557,871	0	298,531	5,889,185

Build Africa Holdings Limited										Appendix 1
Clay - Kaoline Bricks Manufacturing Project										
Projected Profit and Loss Accounts for years										**USD**
Year			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
		Reference								
Revenues		Annex 2	**57,247,706**	**64,231,927**	**72,068,222**	**73,509,586**	**74,979,778**	**76,479,373**	**78,008,961**	**79,569,140**
Less: Direct operating costs		Annex 3 (a)	24,307,290	27,272,780	30,600,059	31,212,060	31,836,301	32,473,027	33,122,488	33,784,937
Gross Profit			**32,940,416**	**36,959,147**	**41,468,163**	**42,297,526**	**43,143,477**	**44,006,346**	**44,886,473**	**45,784,203**
Less: Indirect Operating expenses		Annex 3 (a)	12,594,495	14,131,024	15,855,009	16,172,109	16,495,551	16,825,462	17,161,971	17,505,211
Earnings before depreciation (EBITDA)			**20,345,921**	**22,828,123**	**25,613,154**	**26,125,417**	**26,647,926**	**27,180,884**	**27,724,502**	**28,278,992**
Less: Depreciation		Annex 3 (b)	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Earnings before loan interest and tax (EBIT)			**14,307,491**	**16,789,694**	**19,574,725**	**20,086,988**	**20,602,151**	**21,917,389**	**22,461,007**	**23,015,497**
Less: Loan interest		Annex 4 (a..c)	3,164,549	2,828,964	2,418,355	1,964,751	1,463,648	910,073	298,531	
Operating profit/(loss) before tax (EBT)			**11,142,942**	**13,960,730**	**17,156,369**	**18,122,237**	**19,138,503**	**21,007,316**	**22,162,475**	**23,015,497**
Less: Corporation tax @	30%		3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Profit/(loss) after tax (EAT)			**7,800,060**	**9,772,511**	**12,009,459**	**12,685,566**	**13,396,952**	**14,705,121**	**15,513,733**	**16,110,848**
Add: Profit/(Loss) b/fwd			-	7,800,060	17,572,571	29,582,029	42,267,595	55,664,547	70,369,668	85,883,401
Profit/(loss) c/fwd			**7,800,060**	**17,572,571**	**29,582,029**	**42,267,595**	**55,664,547**	**70,369,668**	**85,883,401**	**101,994,248**

Build Africa Holdings Limited									**Appendix 2**	
Clay - Kaoline Bricks Manufacturing Project										
Projected Cash flows for years										**USD**
Year		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Reference								
Cash inflows									
Capital									
Equity	Annex 1 (c)	21,445,378							
Loan	Annex 1 (c)	32,168,000							
Sub total		53,613,378							
Revenue									
Profit before tax	Appendix 1	11,142,942	13,960,730	17,156,369	18,122,237	19,138,503	21,007,316	22,162,475	23,015,497
Depreciation	Annex 3 (b)	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Sub total		17,181,372	19,999,159	23,194,799	24,160,667	25,184,278	26,270,811	27,425,970	28,278,992
Total Cash inflows		**70,794,750**	**19,999,159**	**23,194,799**	**24,160,667**	**25,184,278**	**26,270,811**	**27,425,970**	**28,278,992**
Cash outflows									
Capital									
Investments	Annex 1 (c)	52,184,000							
Re-investments		-	-	-	509,425	-	-	-	-
Loan repayments	Annex 4 (a..c)	2,113,422	3,921,273	4,331,881	4,785,486	5,286,589	5,840,164	5,889,185	-
Sub total		54,297,422	3,921,273	4,331,881	5,294,911	5,286,589	5,840,164	5,889,185	-
Revenue									
Change in working capital	Annex 3 (a)	1,429,378	174,384	195,659	35,988	36,708	37,442	38,191	38,955
Corporation tax	Appendix 1	3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Sub total		4,772,261	4,362,603	5,342,570	5,472,660	5,778,259	6,339,637	6,686,934	6,943,604
Total Cash outflows		**59,069,683**	**8,283,876**	**9,674,451**	**10,767,571**	**11,064,848**	**12,179,801**	**12,576,119**	**6,943,604**
Net cash flows		**11,725,067**	**11,715,284**	**13,520,348**	**13,393,096**	**14,119,430**	**14,091,010**	**14,849,851**	**21,335,388**
Add: Beg Cash balance		-	11,725,067	23,440,350	36,960,698	50,353,794	64,473,224	78,564,234	93,414,086
Closing cash balance		**11,725,067**	**23,440,350**	**36,960,698**	**50,353,794**	**64,473,224**	**78,564,234**	**93,414,086**	**114,749,474**

Build Africa Holdings Limited									**Appendix 3**	
Clay - Kaoline Bricks Manufacturing Project										
Projected Balance sheets as at end of year										**USD**
Year		1	2	3	4	5	6	7	8
	Reference								
Non-Current Assets	Annex 3 (b)	46,145,571	40,107,141	34,068,712	28,539,707	22,493,932	17,230,437	11,966,942	6,703,446
Current Assets									
Stocks	Annex 3 (a)	2,119,206	2,377,749	2,667,834	2,721,191	2,775,615	2,831,127	2,887,749	2,945,504
Debtors	Annex 3 (a)	2,385,321	2,676,330	3,002,843	3,062,899	3,124,157	3,186,641	3,250,373	3,315,381
Cash	Appendix 2	11,725,067	23,440,350	36,960,698	50,353,794	64,473,224	78,564,234	93,414,086	114,749,474
Sub total		16,229,594	28,494,429	42,631,375	56,137,884	70,372,996	84,582,002	99,552,208	121,010,359
Total Net Assets		**62,375,164**	**68,601,570**	**76,700,086**	**84,677,592**	**92,866,928**	**101,812,439**	**111,519,150**	**127,713,805**
Financed by									
Equity and Liabilities									
Equity									
Paid up share capital	Annex 1 (c)	21,445,378	21,445,378	21,445,378	21,445,378	21,445,378	21,445,378	21,445,378	21,445,378
Retained earnings	Appendix 1	7,800,060	17,572,571	29,582,029	42,267,595	55,664,547	70,369,668	85,883,401	101,994,248
Sub total		29,245,438	39,017,948	51,027,407	63,712,973	77,109,925	91,815,046	107,328,779	123,439,626
Long term loan	Annex 4 (a..c)	30,054,578	26,133,305	21,801,424	17,015,938	11,729,349	5,889,185	0	
Current Liabilities									
Creditors	Annex 3 (a)	3,075,149	3,450,317	3,871,256	3,948,681	4,027,654	4,108,207	4,190,372	4,274,179
Taxation	Appendix 1/2	-	-	-	-	-	-	-	-
Total		3,075,149	3,450,317	3,871,256	3,948,681	4,027,654	4,108,207	4,190,372	4,274,179
Total Liabilities		33,129,726	29,583,622	25,672,679	20,964,619	15,757,003	9,997,393	4,190,372	4,274,179
Total Equity and Liabilities		**62,375,164**	**68,601,570**	**76,700,086**	**84,677,592**	**92,866,928**	**101,812,439**	**111,519,150**	**127,713,805**
Error check		-	-	-	-	-	-	-	-

Build Africa Holdings Limited											**Appendix 4**
Clay - Kaoline Bricks Manufacturing Project											
Discounted Cash Flows - Internal Rate Return											**USD**
Year		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Reference									
Cash inflows										
Profit before interest and tax	Appendix 1	-	14,307,491	16,789,694	19,574,725	20,086,988	20,602,151	21,917,389	22,461,007	23,015,497
Depreciation	Annex 3 (b)	-	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Residual value of fixed assets	Annex 3 (b)	-	-	-	-	-	-	-	-	6,703,446
Recoupment of working capital	Annex 3 (a)	-	-	-	-	-	-	-	-	1,986,706
Total cash inflows		**-**	**20,345,921**	**22,828,123**	**25,613,154**	**26,125,417**	**26,647,926**	**27,180,884**	**27,724,502**	**36,969,144**
Cash outflows										
Investments	Annex 1 (c)	52,184,000	-	-	-	-	-	-	-	-
Reinvestments	Annex 3 (g)		-	-	-	509,425	-	-	-	-
Corporation tax	Appendix 1	-	3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Change in working capital	Annex 3 (f)	-	1,429,378	174,384	195,659	35,988	36,708	37,442	38,191	38,955
Total cash outflows		**52,184,000**	**4,772,261**	**4,362,603**	**5,342,570**	**5,982,085**	**5,778,259**	**6,339,637**	**6,686,934**	**6,943,604**
Net cashflows		**(52,184,000)**	**15,573,660**	**18,465,520**	**20,270,584**	**20,143,332**	**20,869,667**	**20,841,247**	**21,037,568**	**30,025,540**
IRR		**32.79%**								

Build Africa Holdings Limited **Appendix 5**

Clay - Kaoline Bricks Manufacturing Project

Sensitivity analysis of the Project's Profitability

Factors considered		**IRR**
Base case		32.79%
1. Reduction of selling prices by	10.00%	25.07%
2. Increase in operating costs by	10.00%	26.44%
3. Reduction of production capacity utilisation by	10.00%	29.38%
4. Reduction in CAGR's capacity utilization CAGR by	10.00%	32.38%

Build Africa Holdings Limited										**Appendix 6**
Clay - Kaoline Bricks Manufacturing Project										
Net Present Value Analysis										**USD**
(Based on a discount rate of 16% which the WACC)										
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Reference									
Cash inflows										
Profit before tax	Appendix 1	-	11,142,942	13,960,730	17,156,369	18,122,237	19,138,503	21,007,316	22,162,475	23,015,497
Depreciation	Annex 3 (b)	-	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Residual value of fixed assets	Appendix 3	-								6,703,446
Recoupment of working capital	Annex 3 (a)	-	-	-	-	-	-	-	-	1,986,706
Total cash inflows		**-**	**17,181,372**	**19,999,159**	**23,194,799**	**24,160,667**	**25,184,278**	**26,270,811**	**27,425,970**	**36,969,144**
Cash outflows										
Investments	Annex 1 (c)	52,184,000								
Re-investments	Annex 3 (b)	-	-	-	-	509,425	-	-	-	-
Corporation tax	Appendix 1	-	3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Change in working capital	Annex 2 (b)	-	1,429,378	174,384	195,659	35,988	36,708	37,442	38,191	38,955
Total cash outflows		**52,184,000**	**4,772,261**	**4,362,603**	**5,342,570**	**5,982,085**	**5,778,259**	**6,339,637**	**6,686,934**	**6,943,604**
Net cashflows		**(52,184,000)**	**12,409,111**	**15,636,556**	**17,852,229**	**18,178,582**	**19,406,019**	**19,931,174**	**20,739,037**	**30,025,540**
NPV	**22,006,678**									

Build Africa Holdings Limited **Appendix 7**

Clay - Kaoline Bricks Manufacturing Project

Payback Period **USD**

Initial Investment Capital Cost **53,613,378**

YEAR	PROFIT AFTER TAX	DEPRECIATION	TOTAL	CUMULATIVE
1	7,800,060	6,038,429	13,838,489	13,838,489
2	9,772,511	6,038,429	15,810,940	29,649,430
3	12,009,459	6,038,429	18,047,888	47,697,318
4	12,685,566	6,038,429	18,723,995	66,421,313
5	19,138,503	6,038,429	25,176,932	91,598,245
6	14,705,121	5,263,495	19,968,616	111,566,862
7	15,513,733	5,263,495	20,777,228	132,344,090
8	16,110,848	5,263,495	21,374,343	153,718,433

Cumulative benefit at end of year 3 47,697,318

Difference to be recouped in year 4 5,916,060

So the payback period of the project is 3 years and 4 months **3.79**

Build Africa Holdings Limited												**Appendix 8**
Expected Key Financial Performance Indicators												**USD**
	Reference											
Year			**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Project Cost											
Total Project Capital Cost	Annex 1 (c)	USD	53,613,378								
Financial position											
Total Net assets	Appendix 3	USD		62,375,164	68,601,570	76,700,086	84,677,592	92,866,928	101,812,439	111,519,150	127,713,805
Equity Funds	Appendix 3	USD		29,245,438	39,017,948	51,027,407	63,712,973	77,109,925	91,815,046	107,328,779	123,439,626
Long term loan	Appendix 3			30,054,578	26,133,305	21,801,424	17,015,938	11,729,349	5,889,185	0	-
Closing cash balance	Appendix 2	USD		11,725,067	23,440,350	36,960,698	50,353,794	64,473,224	78,564,234	93,414,086	114,749,474
Revenue and profitability											
Revenue	Appendix 1	USD		57,247,706	64,231,927	72,068,222	73,509,586	74,979,778	76,479,373	78,008,961	79,569,140
Gross profit	Appendix 1	USD		32,940,416	36,959,147	41,468,163	42,297,526	43,143,477	44,006,346	44,886,473	45,784,203
Earnings before interest, tax, deprn & amortization (EBITDA)	Appendix 1	USD		20,345,921	22,828,123	25,613,154	26,125,417	26,647,926	27,180,884	27,724,502	28,278,992
Earnings before interest and tax (EBIT)	Appendix 1	USD		14,307,491	16,789,694	19,574,725	20,086,988	20,602,151	21,917,389	22,461,007	23,015,497
Earnings before tax (EBT)	Appendix 1	USD		11,142,942	13,960,730	17,156,369	18,122,237	19,138,503	21,007,316	22,162,475	23,015,497
Earnings after tax (EAT)	Appendix 1	USD		7,800,060	9,772,511	12,009,459	12,685,566	13,396,952	14,705,121	15,513,733	16,110,848
Profit margins											
Gross profit margin				57.54%	57.54%	57.54%	57.54%	57.54%	57.54%	57.54%	57.54%
Earnings before interest, tax, deprn & amortization (EBITDA) margin				35.54%	35.54%	35.54%	35.54%	35.54%	35.54%	35.54%	35.54%
Earnings before interest and tax (EBIT) margin				24.99%	26.14%	27.16%	27.33%	27.48%	28.66%	28.79%	28.93%
Earnings before tax (EBT) margin				19.46%	21.73%	23.81%	24.65%	25.52%	27.47%	28.41%	28.93%
Earnings after tax (EAT) margin				13.63%	15.21%	16.66%	17.26%	17.87%	19.23%	19.89%	20.25%
Return on Capital											
Return on Capital employed (ROCE)				32.62%	33.28%	33.39%	30.85%	28.69%	26.70%	24.86%	22.14%
Return on equity (shareholders funds) - ROE				26.67%	25.05%	23.54%	19.91%	17.37%	16.02%	14.45%	13.05%
Loan service ability											
Loan interest cover				0.16	0.12	0.09	0.08	0.05	0.03	0.01	-
Debt service coverage ratio				2.95	2.74	3.00	3.06	3.09	3.09	3.40	-
Measure of indebtedness											
Tangible assets	Appendix 3	USD		26,116,318	36,671,109	49,462,847	62,930,693	77,109,925	91,815,046	107,328,779	123,439,626
Debt/equity (Gearing) ratio (Extent of debt vs Equity funds)				1.13	0.76	0.50	0.33	0.20	0.11	0.04	0.03
Liquidity ratio											
Liquid ratio				5.28	8.26	11.01	14.22	17.47	20.59	23.76	28.31
Quick (Acid test) ratio				4.59	7.57	10.32	13.53	16.78	19.90	23.07	27.62
Trading ratios											
Stock turnover ratio (no. of times stocks are sold)				11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47
Credit taken (no. of days of credit taken)				30.42	30.42	30.42	30.42	30.42	30.42	30.42	30.42
Credit given (no. of days of credit given)				15.21	15.21	15.21	15.21	15.21	15.21	15.21	15.21
Viability ratios											
Internal rate of return (IRR)	Appendix 4		32.79%								
Net present value (NPV)	Appendix 5	USD	22,006,678								
Payback period - Years	Appendix 6		4.00								
Weighted Average Cost of Capital (WACC) - Assume Cost of Equity is 25%	Annex 1 (c)		16.00%								

BUILD AFRICA HOLDINGS LIMITED

PROJECT PROFILE
DODOMA CLAY BRICK PROJECT

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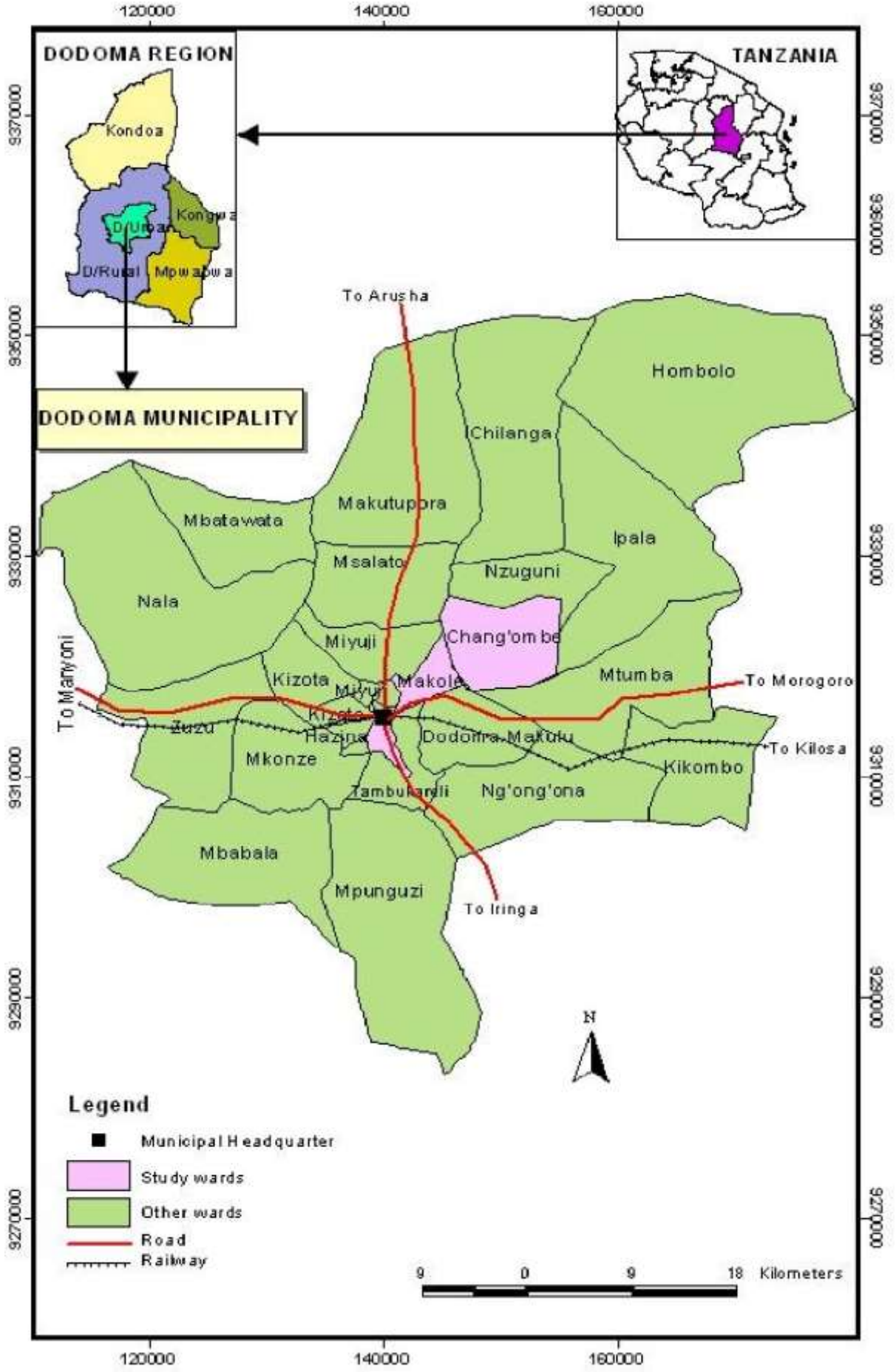
September, 2020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DODOMA REGION
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DODOMA MUNICIPALITY
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Hombolo
Chilanga
Makutupora
Mbalawala
Msalato
Ipala
Nzuguni
Nala
Chang'ombe
Miyuji
Kizota
Makole
Mtumba
To Morogoro
To Manyoni
Zuzu
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Dodoma Makulu
To Kilosa
Mkonze
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EXECUTIVE SUMMARY

The need for sustainable human settlements in Tanzania for urban and rural residents is crucial. This is because housing is a basic need. It plays a pivotal role in economic growth and development. Housing demonstrates the quality of life and socio-economic condition of people in an economy. A house is one of the most preferred and valuable assets that provides both physical and mental strength and a psychological satisfaction, especially to the rural people who are the most vulnerable to natural hazards, pests and wild animals. Some surveys on houses conducted in developing countries indicate that in these countries priority for housing is higher than education and health (Ferguson, Bruce and Haider, Elinor 2000). However, the low segmented housing sector across most less developed countries is undeveloped and constrained by several factors; such as, high construction costs; issues relating to land, access to housing finance, fund mobilization, stringent regulatory frameworks; difficulties in procuring building materials; inadequate skilled construction workers; less awareness on access and adoption of appropriate housing technologies; and some unfavourable housing policies at international, national and sub-national levels. All of these factors generally impinge on the construction of adequate, affordable houses, both in urban and rural areas.

In this context, therefore, the provision of adequate housing, especially to the economically disadvantaged sections in Society, is a major development intervention factor across developing countries, including Tanzania. It is an even more serious issue in this country where population grows at more than 3 percent pa, and the rural to urban migration rate is very high, causing serious challenges of expanding slums and inadequate social services provisioning in undesignated areas.

Tanzania suffers from a terrible shortage of good quality houses. So dire is this shortage that, the nation currently carries a 3 million housing deficit; coupled with an annual 200,000- housing units' demand. Over seventy percent of its urban residents live in unplanned and subserviced informal settlements; with a very large disparity between urban and rural households. Two in three households in Tanzania (67 percent) live in dwellings with earth, sand or dung flooring. Cement flooring only accounts for 30 percent of households.

The main challenge in the provision of decent houses in Tanzania is seeking a substantial reduction in building costs by applying materials which are more cost effective and facilitate greater speed in construction; while ensuring that the requirements of house occupants for security, comfort and low lifecycle costs are catered for.

It is essential to apply technologies which use minimal resources due to inadequate energy and raw materials; but also, to enhance supply capacity, national competitiveness and local value-addition; as well as avoid environmental damage, waste and inefficient energy use.

More specifically, in Tanzania, bulk supply of building materials stands as a big challenge to drive down construction costs. Hence, the need for appropriate building materials and technologies is of great importance in order to drive down the total construction costs. A material which can be locally available and produced with such introduced technology allows large scale mechanized production.

It is important to stress that, building materials are the single most promising area for reducing construction costs. This is due to the fact that they account for 70% of these costs; making 42% of the total costs in constructing a typical Tanzanian 81m^2 house. In many cases, green building materials, such as clay bricks, provide significant cost savings, while offering residents superior levels of quality and comfort. Clay bricks are a highly viable alternative to vibrated cement blocks. Like many other African countries, including Zambia, Zimbabwe, Botswana, Angola and South Africa, Tanzania is endowed with rich clay deposits in various regions all over the country.

On the basis of this fact, Build Africa Holdings (BAH) Limited is seeking financial support from prospective investors to finance its **Dodoma Clay Bricks Project (DCB) in Dodoma.** The Project's key Objectives are: *first*, application of appropriate technology to manufacture clay-based building material; *second*, high utilization of abundant local resources clay deposit, natural gas for firing or coal, *third,* scale down construction costs; and, *fourth,* promote the availability of affordable housing in the country. This Project will have two Phases.

(i) **Phase I:** Project Preparations: mainly involving physical identification and geological mapping of clay deposits; fine-tuning the Project's technical design requirements; fulfilling compliance requirements, such as environmental impact assessment, EIA; and detailing the Project Plan;

(ii) **Phase II:** Factory Setting: primarily involving establishment of the Factory at the chosen site.

Context to the above Project framework, it is estimated that both Phase I and Phase II will cost around USD 53 million for putting- up a semi-automatic plant, with working capital included.

DCB Project financial projections indicate acceptable NPV and IRR to enable the project pay back initial capital cost invested full at the fourth year. The said NPV for this project is 22.0 million and IRR of 33% (see app. 7 & 8).

This Project, is designed to bring about a sustainable solution to the high building costs overly dependent on cement and excessive use of steel iron bars when constructing a house. The Project would involve manufacturing other essential building materials, such as roofing tiles, pavers, water tanks and joinery accessories, which are currently also inadequate.

A study conducted by SwissContact Titled "Clay Brick Production Survey SADC – 2017" revealed that Tanzania is among 11 SADC countries having abundant clay deposits, but with the lowest clay utilization rates within the region; due, especially, to the lack of appropriate technology to exploit these clay resources.

In Tanzania, currently, clay bricks are produced primarily by small-scale informal sector, using wood, charcoal and rice husks as primary source of fuel to fire the bricks. If Tanzania manages to establish even 5 clay building material manufacturing factories, more than 105,000 direct jobs would be created; including, a large number of semi-skilled labourers in the production process, brick layers, handlers, supporters, technicians, distributors and transporters.

Current dynamics in the construction industry demand necessary transformation through mechanised modenisation and product diversification, in order to exploit huge demand for green buildings in our towns and cities. This takes into consideration the fact that, Tanzania housing and construction sector is currently highly dominated by the use of cement which (as of now, is not only in short supply, but also carries some negative consequences, like excessive inhouse warming/hotness in dry seasons), needs massive combinations of other materials like steel iron bars, sand, water and gravel.

Given the above facts, it is only clay building materials which can transform the housing industry, lower building costs, so as to facilitate the construction of affordable houses in Tanzania.

Table of Contents

1. Project Description

1.1 Background

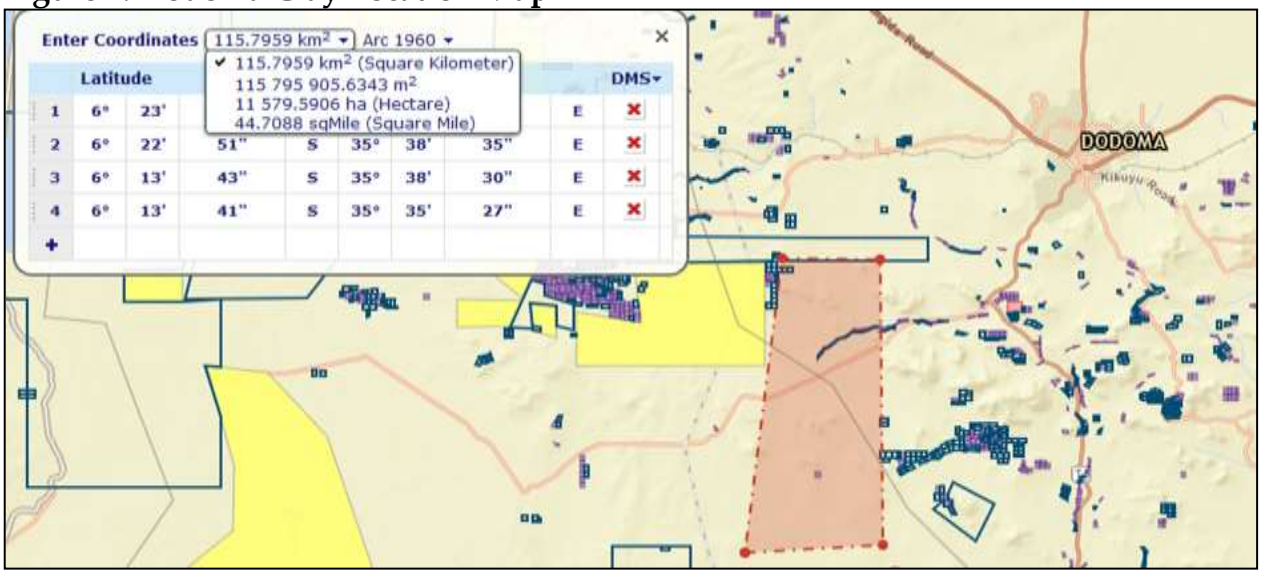
Dodoma Region is located in the Central part of Tanzania, having an area of about 41,311Km^2, situated between DMS latitude longitude coordinates 6°10'19.96"S, 35°44'22.09"E. It is the Capital City of Tanzania, endowed with considerable wealth in natural resources, with a record of over 3 minerals of proven reserves. According to geological surveys carried out such deposits includes, Limestone, Clay, Heavy mineral and sand (Gypsums). These minerals have some prospect for industrial use. However, clay minerals appear not to be the most valuable among the minerals of the earth surface, yet they affect life on earth in far reaching ways. Clay is used in the manufacture of refractory products such as firebricks and blocks, insulating bricks, refractory mortars and mixes, and monolithic and castable materials. There is substantial huge deposit of clay in Dodoma Region. The recent survey indicates, clay deposit in Dodoma Urban may cover approximately 115.7959km^2 extending from Zuzu, Chididimo, Bihawana, Chizomoche, Isanha to Mwitikira Village in the Bahi District. Two former brick factory were within this area.

1.2 The Project

Build Africa Holdings Ltd registered in the United Republic of Tanzania in collaboration with Beta Holdings Group, a Private Company registered in the Republic of zimbabwe intends to build a clay brick factory, **Dodoma Clay Brick (DCB)** in Mbabala Ward, Dodoma Urban District. The factory project will be implemented by YingFeng Machinery co. Ltd from China. DCB Factory will manufacture bricks, roofing tiles, water tanks, pavers and joinery accessories using clay. With new technology, the factory is expected to manufacture 500,000 to 1,000,000 bricks per day. When this factory is completed, it will supply its products countrywide especially in Dodoma to cater for Capital City Projects such as the modern government city at Mtumba, Hotels, shopping malls, schools and Hospitals, commercial and residential houses. It is expected that, clay building material produced will drive down the construction costs, originates from overreliance on cement products. There will be also greater speed in the construction process, eliminating embedded hidden indirect costs when using cement materials. Much greater, clay building material produced will largely contribute making Dodoma capital a ''Green City'' through conserving the environments by reducing excessive use of sand, gravel and water associated with cement use, giving soil its naturality to support plants, because cement materials is associated with draught occuring around premises making soil hard to support plants.

2. Project Location

Figure 1: Dodoma Clay Location Map



Source: Mining Commission Portal – Tanzania, June 2020

Clay location area, can be reached by road, about 30km South West from the Dodoma central business district, CBD. It is located within former clay brick site used to manufacture fired bricks by Catholic White Fathers in Bihawana village.

3. Project History and Current Status

There exist many geological records available of explorations conducted in Dodoma, apart from that done by the Geological Survey of Tanganyika under the British government which indicate clay deposit sites all over the country. Build Africa Holdings (BAH) acquired data relating to the Dodoma area from various geological sources. All sources provide useful information on clay occurrence within this area. BAH has already applied for the mineral rights of the 115.79km² property.

3.1 Explorations

Previous work in Dodoma within the surveyed area by BAH included a Mapping Exploration Program, as the first task undertaken, to establish clay deposits and delineate clay deposits in previously unexplored areas.

The exploration exercise confirmed clay occurrence sites within the 115.79Km sq. Area; but also identified geological features which favors the formation of clay within the surveyed areas.

This work showed that there are significant geochemical targets, as well as areas of historic and current clay mining in attractive geology and structures within Bihawana

Hills. Field work carried out by GST hired experts on clay exploration for two years, confirmed Dodoma to have multiple clay reserves potentials for clay bricks and tiles manufacturing, sufficient to cater for housing requirements in Tanzania, even for the entire East African region.

3.2 Project Development

Currently, the Dodoma Dodoma Clay Bricks Project is at a preparatory stage; entailing a number of activities to be carried out as outlined hereunder;

i. Physical re-surveying the entire clay deposit area,

ii. Conduct physical geological mapping to establish the clay strata, so as to determine clay bulkness and its useful time span;

iii. Conducting full Environment Impact Assessment, EIA study;

iv. Acquisition of Project permits,

v. Prepare Project Business Plan.

4. Project Rationale

Clay bricks have been known for centuries as one of the most sought-after and reliable construction materials for durable and decent houses. The Dodoma Clay Bricks and Tiles Project is being promoted by BAH for very compelling factors articulated below.

4.1 Cheapness and Affordability

Today's main challenge in the construction industry in Africa, is the quest to achieve massive

Estimates for CAHF Generic House with Clay Bricks
House Size: 55m^2(2 Rooms)
Bricks Size: 290mm(L)140mm(W)114mm(H)
Wall Type: double Wall

House wall & Plastering		
Bricks Needed 2,754	USD:	1,081/=
Sand Needed 8Tons	USD:	350/=
Cement Needed 17 Bags	USD:	148/=
A. Walling Cost		**1,579/=**
Roofing & Finishing		
Roofing	USD	842/=
Finishing	USD	2,723/=
Labour	USD	474/=
B. Roofing & Finishing		**4,039/=**
Total Costs A+B	**USD**	**5,518/=**

reduction of building costs through using materials that are more cost effective and facilitate greater speed in construction; while ensuring that the requirements of house occupants for security, comfort and low lifecycle costs are catered for.

Housing shortages in many developing countries, including Tanzania, have stimulated efforts to develop construction strategies which use cheap and durable local materials. It is essential to develop technologies which use minimal resources due to limited energy and minimal raw materials; but, as well as enhance supply capacity, national competitiveness, local value-addition, avoid environmental damage, waste and inefficient energy use. This Project will achieve all of the above mentioned factors.

In this regard, the International Development Research Centre, IDRC[1] in Canada noted that one of the most promising building materials is the fired clay bricks.

Clay fired bricks can make it possible to build good quality houses quickly and at lower costs.

Residential, commercial and office buildings can be constructed in many configurations; from detached houses to high-rise apartments. However, different housing types have different implications for building costs. By far, the most common type of low and middle income accommodation in Tanzania, based on prevailing market preferences from buyers, are cement- built, of 2 to 3 bedrooms (detached or semi-detached) houses of 55m^2 to 100m^2. Similar to conditions in other African markets, the approximate cost structure in Tanzania for building such a unit is as follows: 60% of the unit's total costs are on construction (of which 70% are materials and 30% is labour); 10% on infrastructure (electricity, water etc); 10% on professional fees (architects, engineers, required public permits, etc.); 5% on financing; and 5% on contingencies[2] similar to CAHF generic housing costs[3].

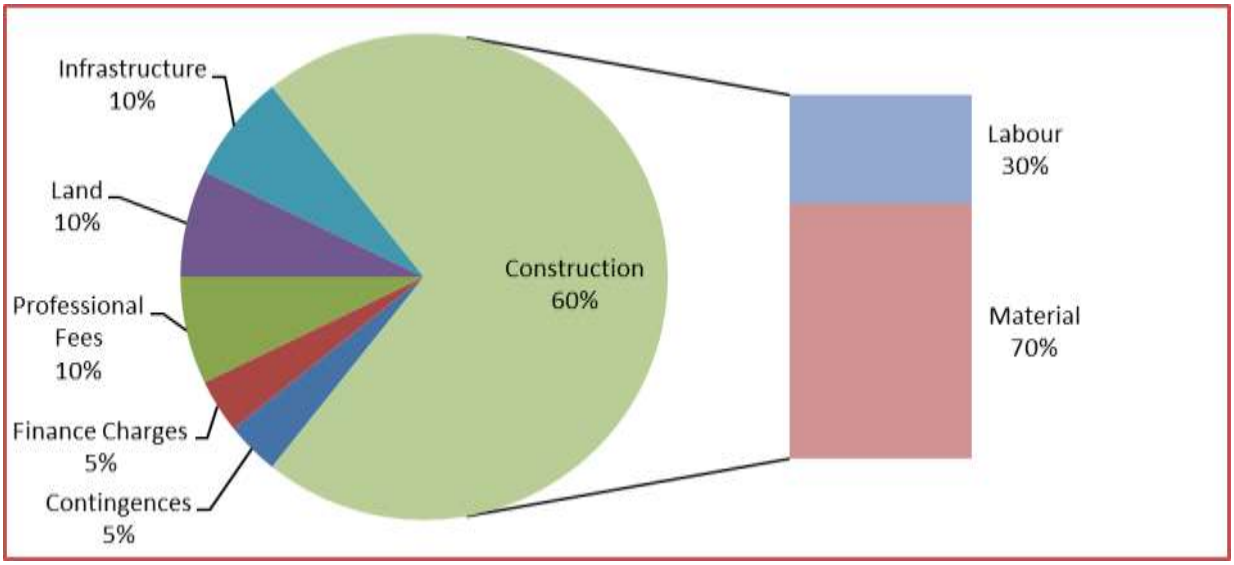
The market price for CAHF generic house is USD 60,869 using vibrated cement blocks compared to USD 5,518 when using clay bricks excluding VAT.

[1] IDRC (2007) Fired Clay Bricks - A New Technique for Production (available online http://www.idrc.ca/en/ev-3165-201-1-DO_TOPIC.html

[2] AfDB (2013) "African Housing Dynamics: Lessons from the Kenyan Market", Africa Economic Brief, Volume 4, Number 3/2013 and *fieldwork interviews*

[3] CAHF (2020) Tanzania Housing Construction and Housing Rental Activities

Fig. 2: Estimated Cost Structure of Building a Typical Tanzanian house



Source: AfDB Informal Survey of Developers 2012, Shelter Afrique Information to the Authors 2012

What clearly emerges from the above Estimated Cost Structure of Building a House in Tanzania is that building materials are the key item with the greatest potential for construction costs reduction, accounting for 42% of the total. In this context, green building materials, such as clay bricks, provide significant cost savings, while offering residents superior levels of quality and comfortable living. Contextually, BAH clay bricks are unquestionably the alternative of choice to vibrated cement blocks. The production cost per clay brick ranges between USD cents 0.08 to 0.2 Such a cost structure similarly prevails in many other African countries, such as Uganda, Zambia, Zimbabwe, Botswana, Namibia and South Africa.

A typical generic house of 55m^2 area requires approximately 3000 cement blocks, equivalent to 75 cement bags of 50kg which are commonly found in local building material outlets all over Tanzania. Cement blocks are then produced by hand shovelling and filling the appropriate moulds. The material cost including steel iron bars for this house, amounts to about US$ 4,000 (TZS 9,175,000), including about 25 tons of concrete block mix and 12 tons of sand. Alternatively, the same structure could be built utilizing approximately 2,754 clay bricks, (Double wall pattern), requiring 23 bags of cement of 50kg each and 8,748 kg of sand, equivalent to 9 tons. Building material costs using clay bricks therefore amounting to about USD 1,579 (See Table 1 below).

Table 1: Comparative Cost Structure of an 55m² House Wall

Type of Building Material	No. of Bricks	Required 50kg Cement Bags	Concrete Mix Material (Ton)	Sand (Ton)	Total Cost	
					USD Equivalent	TZS Equivalent
Cement	3,000	75	25	12	4,000	9,175,000*
Clay	2,754	23	-	9	1,579	3,615,910*

Source: BAH, 2020

* Exchange Rate: 1USD = TZS 2,290

4.2 Acoustic Insulation and Weatherproof

Apart from their natural thermal qualities, clay bricks also have highly sought after acoustic properties which facilitate the reduction of external noise. Acoustic insulation is the ability of a wall to resist the transmission of airborne sound. The density of clay bricks provides maximum insulation against noise.

Clay bricks are rendered water resistant, making them impervious to all forms of weather conditions. They comprise of a fine capillary pore system which has the ability to absorb moisture from rain or water vapour and then release it back into the atmosphere again just as quickly.

Clay bricks are the most reliable and enduring of all building materials. Few other fabricated building units have enjoyed such widespread and continuous popularity.

4.3 Cost Effectiveness

Buildings should be constructed to last; and as such, the life cycle value of a building derived from long term durability, low maintenance and energy savings, should be the key determining factors in such construction. Clay bricks fulfill all of these requirements in ensuring solid quality constructions, and offer long-term, most efficient and cost-effective solutions.

4.4 Energy Efficiency

Clay bricks are renowned for their thermal attributes that provide warmth in winter and cooler conditions in summer; thus ensuring that energy is not squandered on artificial heating and cooling mechanisms.

4.5 Accord With Government Policy on National Housing Programme

A number of relevant policies and regulations have been designed in support of housing matters in Tanzania. In the quest for broad-based affordability and human welfare, the Government considers housing as one of the basic needs for all. The Ministry of Lands, Housing and Human Settlements Development has been mandated to administer land and human settlements in Tanzania on behalf of the President of Tanzania who serves as Trustee of all land. The 2000 National Human Settlements Development Policy is one of the policies and legislation governing human settlements and financing environment in Tanzania. The policy was developed on the Government's determination to address and reverse the deterioration of human settlements conditions in the country. The Government intends to facilitate adequate delivery of shelter and the development of sustainable human settlements in the country. Other policies include, (i) the Mortgage Finance Act; 2008, formulated to provide guiding principles for mortgage financing in Tanzania; and (ii) the Banking and Financial Institutions Regulations; 2015, issued in July 2015 (under the Banking and Financial Institutions Act of 2006) to replace the 2011 regulations. These regulations were developed with the aim of establishing principles to govern housing finance operations for institutions involved in mortgage lending in Tanzania. Key changes made from the 2011 regulations are on minimum capital. Notwithstanding all of these policies, the housing sector still experiences major challenges impinging on its growth and development. High construction costs, emanating from overrelience on cement products, poor infrastructure supply, high house rental charges and high housing prices under mortgage facilities are some of the challenges which need to be addressed.

Moreover, thus far, these policies lack national level coherence, tailored to support the housing sector in the country. Neither does the brick making industry appear to enjoy large-scale, coordinated and proactive Government support. In this context, the Ministry of Lands, Housing and Human Settlements Development plans to present to Parliament a Bill proposing to establish a Real Estate Regulatory Authority (RERA) which will regulate the Housing Industry in the country as well as enact a new Housing Policy in place of the 2000 Policy. The new policy will focus at harnessing existing initiatives in housing delivery and infrastructure investment by the various actors in the public, private, informal and community sectors; as well as guide the rapid urban growth and transformation of settlement patterns.

This Government initiative invites the private and public sectors to invest in the construction industry, including, building materials manufacturing to make these efforts successful.

4.6 Product Durability

Durability is as an important factor in sustainable building design - the longer the building lasts the fewer materials and less energy it will consume over the long term. Clay bricks are durable and timeless building materials which complement the aesthetic and functional needs of any building. Structures that were built from clay bricks and remain standing after centuries of exposure, attest to their durability many times over. Thus, with very little maintenance, buildings made from clay bricks can outlast many generations.

In this regard, clay bricks are the perfect material for Government infrastructure projects, including schools, clinics and hospitals. This is due to their structural and aesthetic integrity, contribution to safety, comfort and wellbeing; at lowest lifecycle costs.

Living examples of the value of clay bricks in Government projects, are the hundreds of schools that have stood the test of time including, Bihawana Seminary in Bihawana, Dodoma, Pugu High School, in Dar es salaam, former Mkwawa High School in Iringa now a University College, even the Dodoma City Municipal Council building. These are good examples to prove the value of clay bricks. In a study that was done to compare schools built by clay bricks versus Alternative Building Technologies (ABT)[4] it was found that, clay bricks walls provide better acoustics, superior thermal comfort during school hours and considerably less maintenance.

4.7 Versatility, Dimensional Accuracy and Symmetry

Clay bricks are made in a variety of colours, shapes, and textures to suit any building application. A key characteristic is the way clay brick walls and pavers remain solid and pleasing even after long term weather exposure.

Clay bricks have the highest dimensional stability and compressive strength. Deformations in buildings can lead to creeping and shrinkage of mortar, which, in turn, can lead to surface cracking due to compressive strains and temperature fluctuations; thus jeopardizing the safety of the entire building. These cracks can be avoided by adapting the structural design to the properties of the building materials, like clay bricks which have extremely low deformation values.

[4]Will ABTs Hold the Public Purse to Ransom? – Peter Kidger, July 2015

4.8 Environmentally Friendly

Made of clay and shale, the final composition of clay bricks includes the four natural elements: earth, wind, fire and water. Therefore, they contain no pollutants or allergens and are resistant to noxious insects. They are also known to have a benign effect on the environment.

The natural insulation properties of clay bricks contribute significantly to the life cycle of a building. Clay bricks have the ability to absorb heat during the day and release it at night, thus reducing the need for artificial heating in winter and cooling in summer.

So much so, that clay bricks are the preferred choice for many residential and commercial projects.

4.9 Huge and Guaranteed Market

The unmet demand for affordable and quality residential housing in the emerging developing world presents one of the biggest challenges and investment opportunities of our time. Comprising such major spending items as rent, mortgages, home improvements and building extensions, the total market for low and middle income housing in the developing world is conservatively estimated to be worth at least some US$200 billion globally over the next ten years. With stable and strong economic growth, youthful demographics and increasing urbanization, Tanzania now is firmly part of that story. There is the huge housing deficit in Tanzania, currently standing at 3,000,000 units; while the housing demand grows at 200,000 units per year. These figures present an enormous opportunity in the construction industry, including the supply of building materials. Across the continent, household spending on residential housing construction is estimated to be growing annually by 4.5% between 2008 and 2020. The rise of the newly emerging middle class drives much of this booming demand, even in Tanzania. Yet, an increasing number of designing Modern Satellite Cities Projects in various places in Tanzania such as the Government City Project in Mtumba Dodoma, Kigamboni New City Project in Dar es salaam, Amber Resort Project in Zanzibar, Pongwe Satellite City in Tanga, Safari City in Arusha, Morogoro Star City Development Project in Tungi (SEZ) area Morogoro, etc; plus various affordable housing projects undertaken countrywide by the National Housing Corporation, Watumishi Housing Company Ltd and Tanzania Building Agency, provide a huge market for clay bricks. It is estimated that, to enable these house building entities fulfill their commitments according to their Strategic Plans; more than 1,000,000 clay bricks are needed daily. Clay bricks, have a great opportunity to cater for that demand.

The recent commitment by the Fifth Phase Government of the United Republic of Tanzania (URT) to implement the decision made about 43 year ago to transfer the capital city from Dar es salaam to Dodoma, is an unenviable opportunity for the construction industry, and especially for the building material sub-sector. As a result of anticipated population increase, some of the areas that would probably need serious investment includes, building of schools, hospitals, commercial and residential houses, industrial buildings, lodges and hotels, shopping malls but also buildings for office space for hire.

The crucial and priceless advice which BAH is making to the Government of The United Republic of Tanzania (URT), with regard to the Capital City relocation, is that, for the first time in the country's history and of the East Africa region, this should be the opportunity to build a modern Green Capital City in Dodoma using clay bricks which conforms to the provisional standards of TZS 1474/EAS 54, the national and regional standards for green building materials and energy efficiency in buildings. BAH wants to assure the Government, that, sufficient clay building materials are available. This is because, parallel to the Dodoma Clay Bricks Project, designed to manufacture 1,000,000 clay bricks daily, there is great chances to erect similar clay bricks and tiles factory in other parts of Dodoma where clay is abudant, including Mpwapwa and Kondoa, specifically to cater for Capital City building Projects. BAH believes, clay building materials will contribute significantly to successfully achieving this noble Government goal, at reasonable cost, in time, and with the appropriate attributes of an enduring modern Green Capital City, in the face challenges emanating from inexorable climatic changes.

4.10 Hub for Sustainable Employment Creation and Welfare Improvement

4.10.1 Social Dimension for Meeting the Needs of Everyone

Clay brick manufacturing plays a major role in the creation and renovation of the built environment. It is fundamental to the provision of housing and shelter. As a significant employer, the factory will shape the personal development and welfare of those who work within it. Initially the clay bricks factory will create more than 2,000 permanent job opportunities; with a multiplier jobs creation impact of more than 21,000 jobs to the entire construction industry. It will also provide support and benefits for the local neighboring communities.

4.10.2 Supporting Neighborhoods

Apart from direct employment that will be created, the factory will make significant contribution to welfare improvements to local communities through;

- Food vending employment;
- Shops and local material supplies to the factory and to the factory staff families;
- Linkages with neighborhood social services institutions, such as schools, health centres, colleges and other institutions for the benefit of all parties.

4.10.3 Supporting the Community

Clay extraction has a temporary disruptive and adverse environmental impact. However, subsequent restoration often adds value through the provision of leisure facilities and areas dedicated to wildlife and nature conservation. Restoration of clay pits can also provide land for agricultural, aquaculture fishing, tree planting and other productive uses. These activities meet some of society's basic needs.

5. Project Beneficiaries

The Dodoma Clay Bricks Project area is surrounded by more than 70 villages with a total population of more than 150,000 people. The Project intends to contribute significantly to raise per capita income to the entire surrounding communities by providing them with employment opportunities, housing support, education support and other social services.

In general, the Project anticipates to influence positively a number of aspects as outlined below;

i) Increase individual per capita income through employment opportunities;

ii) Cause huge exploitation of available local resources such as clay deposit, natural gas and coal;

iii) Increase national and local development through royalties, levy and other taxes paid to the local and central Governments;

iv) Generate energy ie, electricity and supplement to the national grid, because during firing bricks process, the plant generates 4 megawatts daily;

v) Increase foreign currency;

vi) Provide training opportunities to local builders on the use of clay bricks; and

vii) Building good and affordable houses.

viii) Cause to conserve the environments, such as river beds, rocks and land in general.

6. Estimated Clay Deposits

The clay deposits found in the surveyed area (115.79 Km sq.) are estimated at more than 2 billion metric tonnes. This means if 1,000,000 clay bricks are manufactured per day, with measurements of one brick using 0.022 metric tonnes of clay, the clay deposits life span may take more than 50 years to exhaustion.

7. Clay Bricks Manufacturing Activities in Tanzania

Clay mining activities in Dodoma began during the colonial times, before the 1960s-1990s period. A clay brick factory was built in Bihawana area, owned by Catholic Missionery Fathers from Italy, to produce clay bricks for building Churches and Seminary Schools within Dodoma; a good example of these include Bihawana Catholic Seminary and Bihawana Secondary School in Bihawana village, and the Catholic Cathedral in Dodoma City.

A similar factory was established in Zuzu area, owned by the former Capital Development Authority, CDA, purposely erected to supply clay building materials for the capital city development project in Dodoma.

Another clay bricks factory was in Kisarawe, owned by the Kisarawe Bricks Factory Company Limited, KIBRICO, a subsidiary company to the National Housing Corporation, NHC, to manufacture clay bricks.

Like many other state owned parastatals, the Zuzu Factory and KIBRICO were inefficient and failed to produce the expected results. It was said that technical problems, owing to poor requirements identification, design and production; high energy requirements and poor market segmentation, propelled for their closure. Since that time, there has been no any other attempt to operate formal clay brick manufacturing activities in Tanzania.

8. Environmental Sustainability

The Project will mine and produce clay, bricks, tiles, pavers and allied construction products. Operations on site range from mining of raw clay through to firing of products and ultimate delivery to its clients.

The project recognizes its responsibilities for the wider environment and to the local community. It will comply with all relevant environmental legislations at local, regional and national levels, according to the NEMC guidelines, at a minimum performance, and act to improve the environment performance through appropriate initiatives, controls,

provision of resources and training of employees. The aim is to minimize possible adverse impact on the environment of the activities, products and services.

The project will endeavor to establish extensive rehabilitation and reclamation initiatives by planting existing indigenous trees on the unused soil pits which may help to offset possible carbon emissions generated from the operations. Subsequent to this, unused pits will be filled with water to harbor fish farming program as a means to create income to local communities and sustain their livelihoods.

9. Sources of Finance

- Government Funds
- Multilateral Funds
- Equity capital
- Bank Loan
- Joint Venture

Financing for the Dodoma Clay Bricks Project will primarily be from, equity financing covering 30% of total investment; and 70% loan.

10. Vision

Build Africa Holding , BAH, Limited is a Tanzanian- based Company. It was established and is run by indigenous Tanzanians, raised in rural Tanzania, and exposed to modern life possibilities. BAH's motivating and driving Vision rests on the quest for promoting;

- Technology and equipments which reduce building construction costs;
- Optimal energy consumption;
- Construction of affordable and durable houses for the majority of the people;
- Green Cities and Settlements in urban and rural areas;
- Environmental sustainability, particularly, against the backdrop of relentless climate changes;
- Economic development initiatives through housing;
- Use for local natural resources available like clay deposit, natural gas, coal to its fullest potential.

11. Appendices

This Project Profile also contains explanatory Appendices, as follows;

- **Appendix 1:** Detailed breakdown of the tasks, their respective objectives and accompnying estimated budgets for Phase I of the Project;
- **Appendix 2:** Similar detailed breakdown of the equipments for a 1,000,000 daily clay bricks manufacturing plant;
- **Appendix 3:** An illustrative Clay Bricks Calculator for estimating the number of bricks and other materials to use when building a house;
- **Appendix 4:** Illustrates the Production Lines Flow Chart for a clay products manufacturing plant; and
- **Appendix 5:** Provides examples of typical Clay Manufactured Products.
- **Appendix 6:** Actors in the value chain related to clay building materials
- **Appendix 7:** DCB Project NPV
- **Appendix 8:** DCB Project IRR
- **Appendix 9:** DCB Project Key Financial Performance Indicators (KFPIs)

Appendix 1: Project Preparations - Dodoma Clay Bricks Project

Item	Task	Purpose	Specifics	Deliverable
1.	Technical Team Visit to Tanzania	Site visit, Assessment of Terrain	Water, Electricity, Roads, Manpower, Gas, Coal, Fuels, Clays etc	Report
2.	Clay Deposit	Evaluation of Existing Reports, determine bulkiness, economic value	Analysis and recommendation on suitable production processes.	Report
3.	Compliance Requirements	Familiarisation with Regulatory and Compliance Authorities, NEMC, TBS, NCC, OSHA etc	Health, Safety, Environment, Mining.	Report
4.	Clay Bricks Demand & Supply Assessment	Projections	Buyers, Competitors, Logistics, Administration	Report
5.	Engagement of Equipment Suppliers	Inquiries Original Equipment Manufacturer	Backup, Lead Time, Reliability, Support.	Report
,6.	Designs - Civils	Identification of Positions and Levels.	Layout, Pits, Plinths, Soil Tests.	Drawings
7.	Designs - Electrical	CAD Drawings, Transformers, MCB's	Circuit Diagrams, Specifications, Supply Connections.	Drawings
8.	Designs - Mechanical	Conveying Systems, Chutes and Receivers.	Layout, Specifications.	Drawings
9.	Business Plan	Projections and Costs	Raw Materials, Overheads, Cost Per Unit, ROI.	Report
10.	Construction - Supervision	Sheds, Ablutions, Offices.	Adherence to Specifications and Plans.	Report
11.	Installation - Supervision	Sequencing, Levelling, Connections.	Handling and Care, Adherence to Plans.	Report
12.	Commissioning	Safety and Operation	DOR, Testing, Dry Running, Full Loading.	Report
13.	Production	Efficiency	Meeting Targets	Board Packs
14.	Training	Skills Transfer to Locals	Design of Procedures (End to End). Inculcating Work Culture.	Report

Appendix 2: Project Equipment - Plant capacity level 500,000 clay bricks per day

S/N	ITEMS	Estimates
1	Fencing of Land	
2	Site (Geotech, Debushing, Levelling and Compaction)	
3	Plant Civil Works (Designs/Layout provided by Equipment Supplier)	
4	Borehole Surveying, Sinking and Equipping	
5	Electricity Transformer	
6	Excavator for Mining	
7	Dump Truck x2 for Mining	
8	Front End Loader x 2	
9	Rough Terrain Forklifts x 4	
10	Stockyard Tractor	
11	Farm Trailer	
12	VSD for the Box Feeders	
13	Box Feeders x 2	
14	Lump Breaker (Primary Crusher)	
15	Hammer Mill (Fine Crusher)	
16	Screens	
17	Clay Storage Shed (For Souring)	
18	Box Feeder	
19	Pre-Mixer	
20	Combined Mixer-Extruder with Vacuum Pump	
21	Slug Cutter	
22	Push Through Cutter	
23	Waste Return Chopper	
24	Setting Platform	
25	Automated Drier	
26	Tunnel Kiln (with Control System)	
27	Kiln Cars x 100	
28	Kiln Car Transfer System	
29	Rail Line	
30	Complete Conveyor Belt System, Rollers, Hoppers, Chutes, Drives, etc.	
31	MCC and Electrical Cabling (Procure and Install)	
32	Standby Generator Set	
33	Compressed Air System	
34	Sorting Platform	
35	Kiln Fuel Storage	
36	Mobile Plant Fuel Storage	
37	Brick Delivery Trucks x 5	
38	Coal Tipper Trucks x 2	
39	Fully Fitted Laboratory	

40	Fully Stocked Wearing Parts and Consumables Spares Storeroom	
41	Fully Stocked Maintenance Workshop	
42	Plant Shed	
43	Ablutions	
44	Office Block	
45	Technical Consultancy and Supervision	

Appendix 3: Clay brick calculator for estimating number of brick & other materials to use when building a house

CLAY BRICK CALCULATOR
REQUEST A QUOTE

Brick Calculator for an accurate estimation you will need for building house wall.

Coromaxi

Single Brick Wall

Select Joint Type

Wall in meters ^{2}	**81**
Bricks Needed	**2,754**
Sand Needed	**3.24m^3 (5,832Kg / 6 Tones)**
Cement Needed	**14.58 bags (729Kg) for 0.69m^3 mortar**
Plaster Needs 15mm Thick	
Sand Needed	**1.62m^3 (2,916Kg / 3 Tones)**
Cement Needed	**8.1 bags 405Kg**
Wall in meters ^{2}	**81**

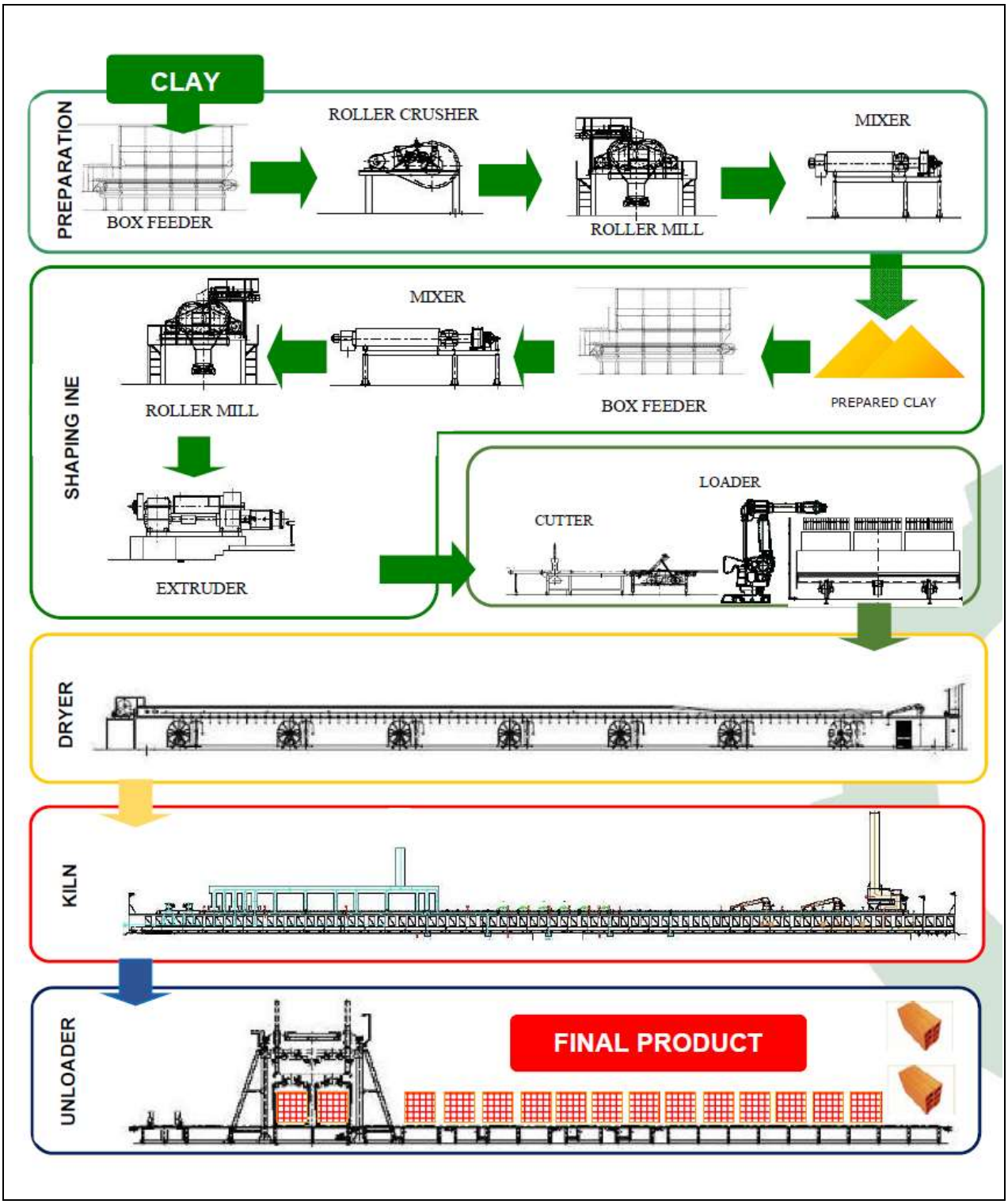
How it works:

1. Simply select the type of brick or paver you wish to use, and enter the length and height of your structure.
2. The brick and paving calculator will calculate the amount of materials needed for the job, including the amount of sand and cement.
3. The brick and paving calculator will also determine how thick the plaster needs to be, and will revert with the quantities of sand and cement needed to mix it to the correct consistency.

SPECIFICATIONS

Name	CoroMaxi 90
Brick Type	Face Brick
Base Colour	Brown
Using	Masonry
Dimension	222 X 90 X 114 mm
Format	Maxi 90
Typical Comp Strength	20-30
Typical 24 Hr Water Absorption	8-10
Efflorescence Rating	Nil / Slight
External Angle 45	0
Internal Angle 45	0

Appendix 4: Flowchart of Production Line



■ Raw material for making Sintered brick

(Note: Raw material 1 is must , 2,3,4,5 is optional raw materia)

1. Clay

2. Shale

3. Coal Gangue

4. Slag

5. Fly ash

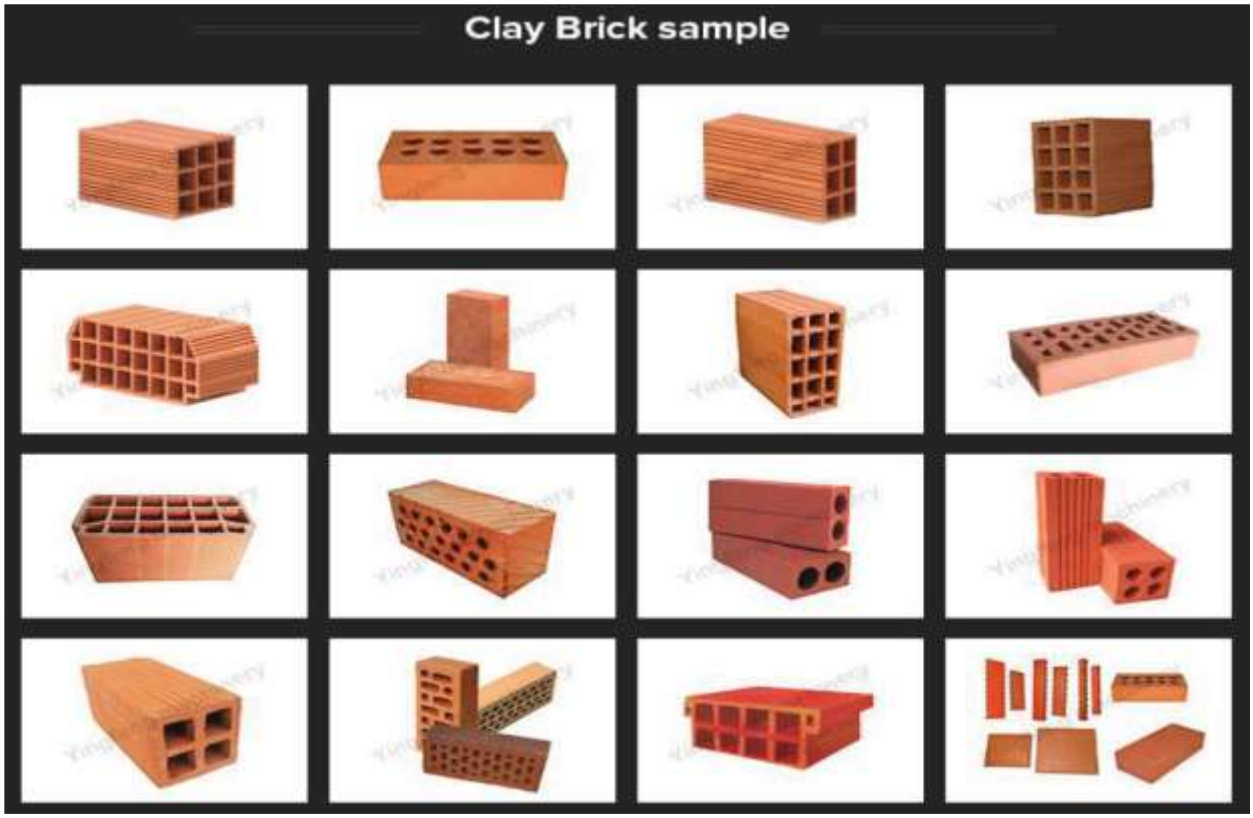
CLAY BRICK MANUFACTURING PROCESS:

In general, clay brick making needs the following 5 stages:

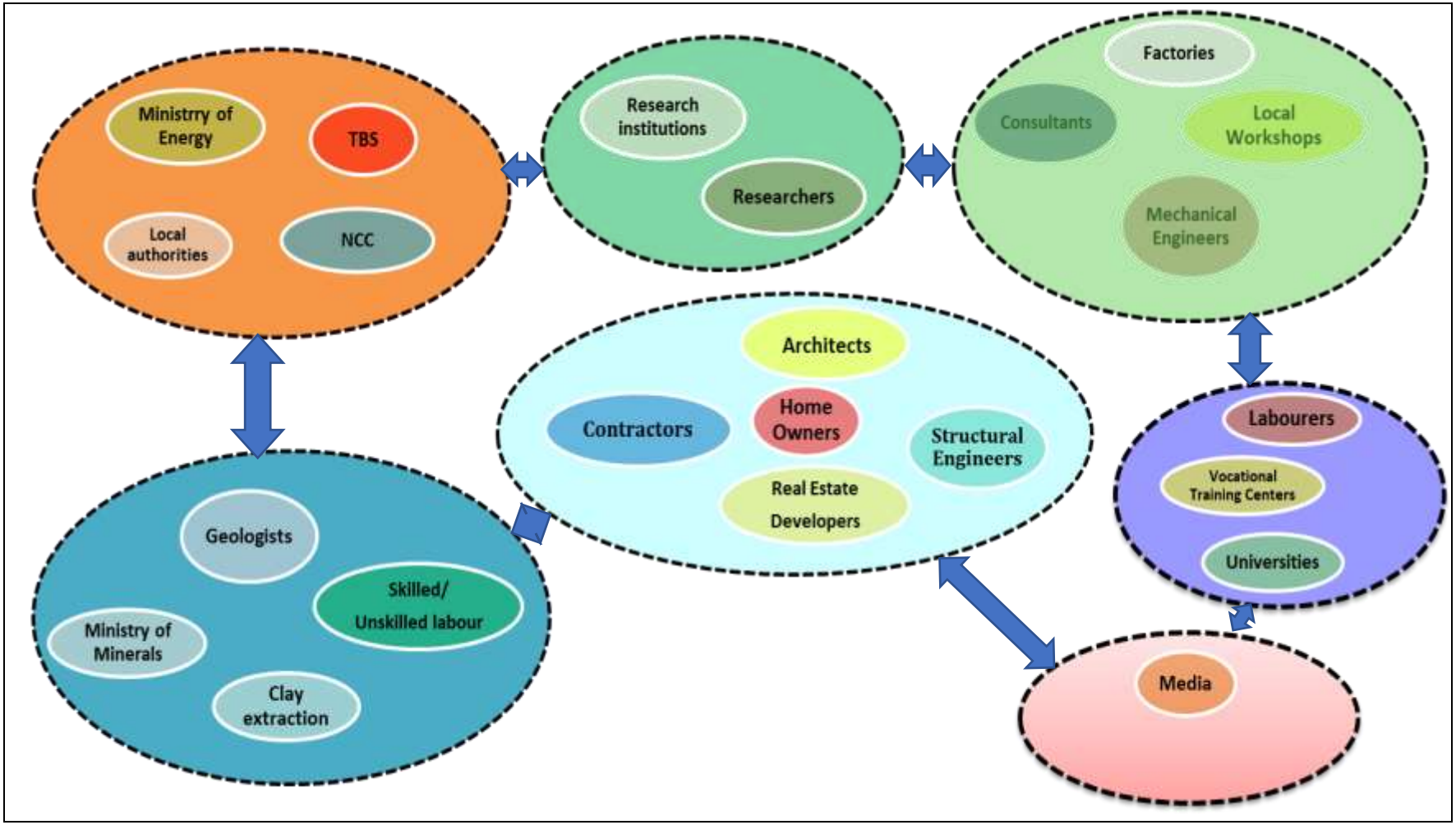
1. **Raw material processing**
   (feeding, screening, crushing, grinding, mixing,aging etc.)
2. **Extruding**
   (using extruder to extrude mud into mud column)
3. **Brick Cutting, stacking, transporting**
4. **Brick Drying**
5. **Brick Firing**

The five components of the process of sintered clay bricks, the importance of each part is generally summarized, the raw materials are fundamental, the molding is the foundation, the drying is guaranteed, and the roasting is the key. These five parts are interdependent.

Appendix 5: Clay Products


Clay Brick sample

Appendix 6: Actors in the value chain related to clay building materials



Legend:

Code Specificatons and Policies

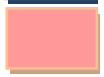
Research and Development

Equipments and Machinery

Training and Education

Raw material Extracti

Clay Material production and use construction

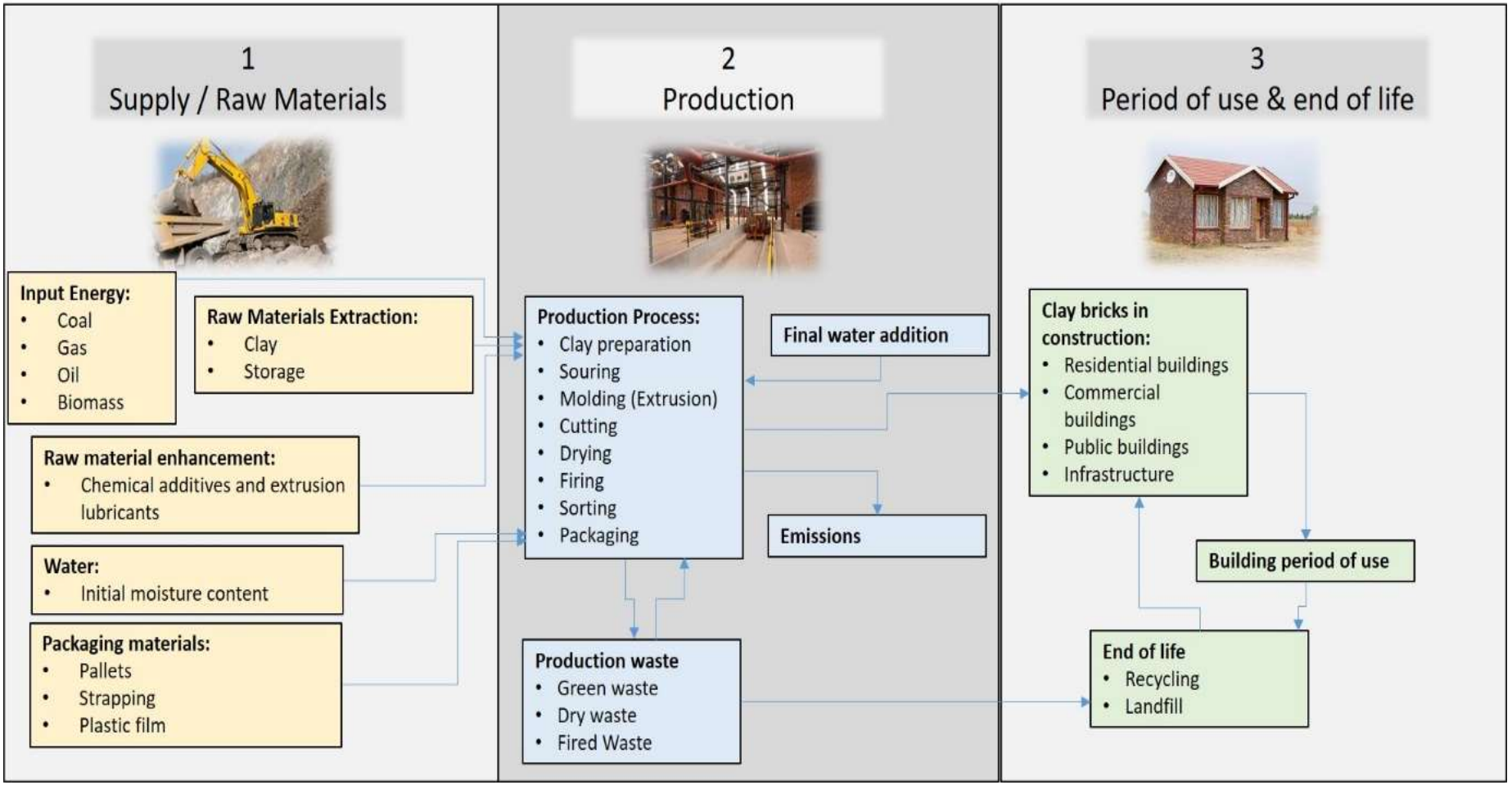


Marketing and Promotion

TBS Tanzania Bureau of

NCC National Constructio

Value Chain: Clay Brick



Appendix 7: DCB Project NPV

Build Africa Holdings Limited										**Appendix 6**
Clay - Kaoline Bricks Manufacturing Project										
Net Present Value Analysis										**USD**
(Based on a discount rate of 16% which the WACC)										
Year		**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Reference									
Cash inflows										
Profit before tax	Appendix 1	-	11,142,942	13,960,730	17,156,369	18,122,237	19,138,503	21,007,316	22,162,475	23,015,497
Depreciation	Annex 3 (b)	-	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Residual value of fixed assets	Appendix 3	-								6,703,446
Recoupment of working capital	Annex 3 (a)	-	-	-	-	-	-	-	-	1,986,706
Total cash inflows		**-**	**17,181,372**	**19,999,159**	**23,194,799**	**24,160,667**	**25,184,278**	**26,270,811**	**27,425,970**	**36,969,144**
Cash outflows										
Investments	Annex 1 (c)	52,184,000								
Re-investments	Annex 3 (b)	-	-	-	-	509,425	-	-	-	-
Corporation tax	Appendix 1	-	3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Change in working capital	Annex 2 (b)	-	1,429,378	174,384	195,659	35,988	36,708	37,442	38,191	38,955
Total cash outflows		**52,184,000**	**4,772,261**	**4,362,603**	**5,342,570**	**5,982,085**	**5,778,259**	**6,339,637**	**6,686,934**	**6,943,604**
Net cashflows		**(52,184,000)**	**12,409,111**	**15,636,556**	**17,852,229**	**18,178,582**	**19,406,019**	**19,931,174**	**20,739,037**	**30,025,540**
NPV	**22,006,678**									

Appendix 8: DCB Project IRR

Build Africa Holdings Limited										**Appendix 4**
Clay - Kaoline Bricks Manufacturing Project										
Discounted Cash Flows - Internal Rate Return										**USD**
Year	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
	Reference									
Cash inflows										
Profit before interest and tax	Appendix 1	-	14,307,491	16,789,694	19,574,725	20,086,988	20,602,151	21,917,389	22,461,007	23,015,497
Depreciation	Annex 3 (b)	-	6,038,429	6,038,429	6,038,429	6,038,429	6,045,775	5,263,495	5,263,495	5,263,495
Residual value of fixed assets	Annex 3 (b)	-	-	-	-	-	-	-	-	6,703,446
Recoupment of working capital	Annex 3 (a)	-	-	-	-	-	-	-	-	1,986,706
Total cash inflows		**-**	**20,345,921**	**22,828,123**	**25,613,154**	**26,125,417**	**26,647,926**	**27,180,884**	**27,724,502**	**36,969,144**
Cash outflows										
Investments	Annex 1 (c)	52,184,000	-	-	-	-	-	-	-	-
Reinvestments	Annex 3 (g)		-	-	-	509,425	-	-	-	-
Corporation tax	Appendix 1	-	3,342,883	4,188,219	5,146,911	5,436,671	5,741,551	6,302,195	6,648,743	6,904,649
Change in working capital	Annex 3 (f)	-	1,429,378	174,384	195,659	35,988	36,708	37,442	38,191	38,955
Total cash outflows		**52,184,000**	**4,772,261**	**4,362,603**	**5,342,570**	**5,982,085**	**5,778,259**	**6,339,637**	**6,686,934**	**6,943,604**
Net cashflows		**(52,184,000)**	**15,573,660**	**18,465,520**	**20,270,584**	**20,143,332**	**20,869,667**	**20,841,247**	**21,037,568**	**30,025,540**
IRR		**32.79%**								

Appendix 9: DCB Project Key Financial Performance Indicators (KFPIs)

Build Africa Holdings Limited												**Appendix 8**
Expected Key Financial Performance Indicators												**USD**
	Reference											
Year			**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Project Cost												
Total Project Capital Cost	Annex 1 (c)	USD	53,613,378									
Financial position												
Total Net assets	Appendix 3	USD		62,375,164	68,601,570	76,700,086	84,677,592	92,866,928	101,812,439	111,519,150	127,713,805	
Equity Funds	Appendix 3	USD		29,245,438	39,017,948	51,027,407	63,712,973	77,109,925	91,815,046	107,328,779	123,439,626	
Long term loan	Appendix 3			30,054,578	26,133,305	21,801,424	17,015,938	11,729,349	5,889,185	0	-	
Closing cash balance	Appendix 2	USD		11,725,067	23,440,350	36,960,698	50,353,794	64,473,224	78,564,234	93,414,086	114,749,474	
Revenue and profitability												
Revenue	Appendix 1	USD		57,247,706	64,231,927	72,068,222	73,509,586	74,979,778	76,479,373	78,008,961	79,569,140	
Gross profit	Appendix 1	USD		32,940,416	36,959,147	41,468,163	42,297,526	43,143,477	44,006,346	44,886,473	45,784,203	
Earnings before interest, tax, deprn & amortization (EBITDA)	Appendix 1	USD		20,345,921	22,828,123	25,613,154	26,125,417	26,647,926	27,180,884	27,724,502	28,278,992	
Earnings before interest and tax (EBIT)	Appendix 1	USD		14,307,491	16,789,694	19,574,725	20,086,988	20,602,151	21,917,389	22,461,007	23,015,497	
Earnings before tax (EBT)	Appendix 1	USD		11,142,942	13,960,730	17,156,369	18,122,237	19,138,503	21,007,316	22,162,475	23,015,497	
Earnings after tax (EAT)	Appendix 1	USD		7,800,060	9,772,511	12,009,459	12,685,566	13,396,952	14,705,121	15,513,733	16,110,848	
Profit margins												
Gross profit margin				57.54%	57.54%	57.54%	57.54%	57.54%	57.54%	57.54%	57.54%	
Earnings before interest, tax, deprn & amortization (EBITDA) margin				35.54%	35.54%	35.54%	35.54%	35.54%	35.54%	35.54%	35.54%	
Earnings before interest and tax (EBIT) margin				24.99%	26.14%	27.16%	27.33%	27.48%	28.66%	28.79%	28.93%	
Earnings before tax (EBT) margin				19.46%	21.73%	23.81%	24.65%	25.52%	27.47%	28.41%	28.93%	
Earnings after tax (EAT) margin				13.63%	15.21%	16.66%	17.26%	17.87%	19.23%	19.89%	20.25%	
Return on Capital												
Return on Capital employed (ROCE)				32.62%	33.28%	33.39%	30.85%	28.69%	26.70%	24.86%	22.14%	
Return on equity (shareholders funds) - ROE				26.67%	25.05%	23.54%	19.91%	17.37%	16.02%	14.45%	13.05%	
Loan service ability												
Loan interest cover				0.16	0.12	0.09	0.08	0.05	0.03	0.01	-	
Debt service coverage ratio				2.95	2.74	3.00	3.06	3.09	3.09	3.40	-	
Measure of indebtedness												
Tangible assets	Appendix 3	USD		26,116,318	36,671,109	49,462,847	62,930,693	77,109,925	91,815,046	107,328,779	123,439,626	
Debt/equity (Gearing) ratio (Extent of debt vs Equity funds)				1.13	0.76	0.50	0.33	0.20	0.11	0.04	0.03	
Liquidity ratio												
Liquid ratio				5.28	8.26	11.01	14.22	17.47	20.59	23.76	28.31	
Quick (Acid test) ratio				4.59	7.57	10.32	13.53	16.78	19.90	23.07	27.62	
Trading ratios												
Stock turnover ratio (no. of times stocks are sold)				11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	
Credit taken (no. of days of credit taken)				30.42	30.42	30.42	30.42	30.42	30.42	30.42	30.42	
Credit given (no. of days of credit given)				15.21	15.21	15.21	15.21	15.21	15.21	15.21	15.21	
Viability ratios												
Internal rate of return (IRR)	Appendix 4		32.79%									
Net present value (NPV)	Appendix 5	USD	22,006,678									
Payback period - Years	Appendix 6		4.00									
Weighted Average Cost of Capital (WACC) - Assume Cost of Equity is 2	Annex 1 (c)		16.00%									