

# Business Plan

## Clay Brick Factory

### Kisarawe District, Tanzania



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## List Abbreviations

NNGCL:	Nyambari Nyangwine Group of Companies Limited
GST:	Geological Survey of Tanzania
TARI:	Tanzania Agricultural Research Institute
USD:	United States Dollar
GDP:	Gross Domestic Product
KIBRICO:	Kisarawe Bricks Company Limited
ToR:	Terms of Reference
CBO:	Community Based Organization
TBA:	Tanzania Building Agency
NHBRA:	National Housing and Building Research Agency
TIC:	Tanzania Investment Centre
SPM:	Sales Performance Management
IDRC:	International Development Research Centre
PPP:	Public Private Partnership
DSRC:	Debt Service Coverage Ratio
WACC:	Weighted Average Cost of Capital
IRR:	Internal Rate of Return
RoE:	Return on Equity
NPV:	Net Present Value
EIA:	Environment Impact Assessment
VSBK:	Vertical shaft Brick Kiln

## **EXECUTIVE SUMMARY**

### **Overview of the Project**

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 Kisarawe, Tanzania*.

**Nyambari Nyangwine Group of Companies Ltd (NNGCL)** 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 Kisarawe Clay Brick Project which apart from manufacturing clay bricks it will also manufacture clay roofing tiles, pavers and water tanks.

### **Summary of Key Findings and Recommendations**

#### **Identification of place with potential clay sites**

A number of potential location sites in Kisarawe reviewed and data collected on the available places containing size of clay deposit area, provision of necessary infrastructure (water and electricity) connectivity to road and rail, access to potential market and social/environmental aspects. This has resulted to Bwama and Yombo Lukinga seen as potential location for clay brick Project in the Kisarawe District.

## **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 NNGCL, 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 Kisarawe District visually and technically, it became evident that clay deposit sites in Yombo Lukinga Village, Bwama and Marui mipera Village were considered preferable sites with potential terrain attractiveness for reduced investment costs.

**Table 1: Kisarawe District Ecological Zones**

<b>CODE</b>	<b>Sub Zone-Area (Sq-Km)</b>	<b>pH (H<sub>2</sub>O)</b>	<b>Temperature (°C)</b>	<b>Soils and Topography</b>	<b>Altitude (m)</b>	<b>Rainfall (mm/Year) / Patten</b>	<b>Length of Growing Period and Soil Moisture Properties</b>
C1		5-7	29-31 19-23	Nearly level to rolling plains of slope range 0-10%, developed on Quaternary, Neogene, Jurassic and Cretaceous sediments. Major soils are well drained, moderately deep to deep, red, yellowish red or orange sands and loamy sands with sandy loams in depth, with poor structure, and very low natural fertility; and moderately well to imperfectly drained, shallow to deep usually calcareous, black, dark grey or brown cracking clays often overlying paler subsoil with ephemeral structure and moderate natural fertility.	< 200	1000-1200 Bimodal	2 dependable growing periods (DGP) per year. Variation of DGP length as function of soil moisture storage capacity and crop rooting habits. Duration is 3-4 months. Main DGP is March-April, while the secondary DGP is October – November. The zone has deep sandy soils with low AWC (30-80 mm/m) and moderate soil depth (1-2m). Poor to moderate moisture storing capacity (S <sub>max</sub> 50-150mm)
C2		5-7	29-31 19-23	Nearly level to gently rolling plains and plateau, slopes ranging from 0-10%, developed on Quaternary, Neogene, Jurassic and Cretaceous sediment. Soils are well drained, moderately deep to deep, red, yellowish red or orange sands and loamy sands with sandy loams in subsoil and poor structure and with very low natural fertility; and moderately well to imperfectly drained, shallow to deep usually calcareous, black, dark grey or brown cracking clays often overlying paler subsoil with ephemeral structure and moderate natural fertility.	< 500	800-1000 Monomodal	One DGP per year with duration of 3-4½ months, with variation of 3-4 weeks depending soil moisture storage capacity and crop rooting habits. Unreliable onset dates. Soils have moderate to high AWC (80-150 mm/m) and favourable moisture storing characteristics (S <sub>max</sub> 150-350 mm).
C3		5-7	29-31 19-23	Strongly dissected uplands and rolling to steep hills, slope range of 10-45%, developed on Jurassic, sandstones, shales,	<500	800-1000 Monomodal	One DGP per year with duration of 3-4½ months, with variation of 3-4 weeks depending soil moisture storage capacity and

				limestones, Paleogene limestone and marls and Neogene sandy clays. Soils are mainly well drained, moderately deep to deep, reddish and yellowish sandy clay loams and sandy clays, often with more sandy topsoil, with weak structure and low natural fertility; and complex of rock outcrops, surface ironstone, very stony and very shallow soils; and important proportion of moderately well to imperfectly drained, shallow to deep, usually calcareous, black, dark grey or brown cracking clays often overlying paler subsoil with ephemeral structure and moderately high natural fertility.			crop rooting habits. Unreliable onset dates  Soils in the zone are characterised to be of low to moderate AWC (80-100 mm/m) and poor to moderate moisture storing properties (Smax 50-150 mm) according to rainfall acceptance.
C4		5.5-7	29-31 19-23	Flat, low altitude riverine floodplains (84%) and deltas (16%) with spatially and temporally varying flooding regimes and sedimentation patterns; mainly covered by young alluvial soils with variable drainage and flooding conditions. Dominant soils are well to moderately well drained, deep, brownish fine sands to sandy clay loams with high textural variability over short distances and highly stratified with more sandy or more clayey layers; and imperfectly to poorly drained, deep, (dark) grey, or grey brown clays, sandy clays or clay loams often mottled and usually with more sandy horizons within the profile and moderate topsoil structure, with high natural fertility; and imperfectly to poorly drained, deep, coarse almost pure bleached sands often with finer texture overly usually with poor natural fertility	<200	1200-14000 Variable	Growing period mainly determined by flooding regime.  The zone moisture characteristics is influenced by flood regimes, drainage variability,
C5		5-7	29-31 19-23	Flat to gently undulating plains, slope range 0-3% developed on old alluvial terrace no longer flooded. Major soils are	< 200	1000-1200 Monomodal	One dependable growing period per year with duration of 3-4½months. Mainly covered by

				well drained, moderately deep to deep, red, yellowish red or orange sands and loamy sands with sandy loams in subsoil, weak structure and very low natural fertility; and moderately well to imperfectly drained, deep, brown, pale yellow, light grey or white mottled sands and loamy sands with weak structure and very low natural fertility; and imperfectly to poorly drained due to flat topography and ponding above ironstone pans in subsoil (0-7 to 1.5 m deep) which prevent deep percolation and are able to maintain perched water tables stable enough rice cultivation.			deep, medium to heavy textured soils with moderate to high AWC (80-150 mm/m) and favourable moisture storing properties (S <sub>max</sub> 150-350 mm). Topographical favours runoff additions and promote flood risk.
S1		5-7	29-31 19-23	Mainly gently undulating to rolling plateau developed on Karroo sandstones and Neogene sandy sediments; low altitude. Major soils are well drained, moderately deep to deep, red, yellowish or red or orange sands and loamy sands with sandy loams in depth, with weak structure and very low natural fertility; and important proportion of moderately well to imperfectly drained, deep, brown, pale yellow, light grey or white mottled sands and loamy sands with weak structure and very low natural fertility.	200-500	800-1000 Monomodal	One DGP per year with duration of 3-4½ months, varying by 3-4 weeks depending on soil moisture storing capacity and crop rooting habits. Unreliable onset dates. The zone is covered by well drained loamy sands with low fertility and poor to moderate moisture storing properties.

Source: TARI Mlingano, Muheza 2018

## 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 480,000 to 1,000,000 bricks per day. It is expected that, clay building material produced in Kisarawe 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	3 Years
Construction starts	01 January 2024
Construction ends	31 December 2025
Operation starts	01 January 2026
Concession ends	31 Dec 2028 (related to No. of concession years)
Repayment starts	2029
Days per year/period assumed	365/366

Source: Consultant, 2023

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 24.0 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 Chole 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.

## **Company Profile**

**Nyambari Nyangwine Group of Companies Ltd (NNGCL)** is a private company wholly owned by local Tanzanians. The authorized share capital of the company is TZS **1,000,000,000/= (ONE BILLION)** divided into **1,000** shares each vested with powers for the company to increase or reduce the said capital, and to issue any part of its capital, original or increased with or without any postponement of right or any conditions.

The company is a limited entity with shares and incorporated under the Companies Act 2002 with a business licence, Certificate of Registration number 81437, Taxpayer Identification Number (TIN) number 112-095-322 and Value Added Tax (VAT) number 40-011471-0.

**Nyambari Nyangwine Group of Companies Ltd** is a private company limited by shares

incorporated in the United Republic of Tanzania with certificate of incorporation No. 81437 dated 10<sup>th</sup> February, 2011.

The authorized share capital of the company is Tanzanian Shillings One Billion (Tshs.100,000,000/=) divided into 1000 shares of shillings 100,000/= each of which the paid-up share capital is Tanzanian shillings One hundred million (Tshs. 100,000,000/=).

Name of Shareholder	Number of Shares	Percentage
Nyambari Nyangwine	500	50%
Margreth Nyangwine	500	50%
<b>Total</b>	<b>1,000</b>	<b>100%</b>

## Conclusion

Of different clay locations surveyed in Kisarawe, clays of Bwama and Yombo Lukinga were considered the best for brick manufacturing due to its viscosity but also having clay extractions for making local bricks and clay cookery stove (majiko Banifu) as a means to reduce massive use of Charcoal. Further, the terrain structure which, though flat and relatively having narrow shaped hills, is much better geo-technically structured than any other locations.

These sites offer 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:

- ✚ Preparation for Project Technical proposal to Investigate further, the geo- technical features of Project sites and the potential clay industrial development activities in the area.
- ✚ Execute an economic feasibility study (Project Profile) to assess the wider economic effects of clay brick factory in Pwani and Dar es Salaam; and
- ✚ If possible, prepare the necessary legal and institutional concession framework for clay brick project after full economic feasibility study has been undertaken.

Nyambari Chacha Mariba Nyangwine  
**Chairman,**  
**Nyambari Nyangwine Group of Companies Limited, Dar es Salaam,**  
**Tanzania**

## 1. 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.

It has an area of approximately 945,087 square kilometers and a population of about 61.7 million, for a total population density of approximately 62 persons per square kilometer.

Tanzania is an East African country that borders on the Indian Ocean.

The 2022 National Census recorded population was 61.7 million, having grown

by three percent. Approximately 34.8 percent of the population live in urban areas and 65.1 percent live in rural areas. Over 60 percent of the population in urban areas live in informal settlements, which are often associated with poor basic amenities. In 2022, the unemployment level was reported at 2.2 percent of the labour force. The economy of Tanzania was TSh145.34 trillion (US\$63.1 billion) in 2022 having grown by 5.8 percent, and this translated into gross domestic product (GDP) per capita of approximately TSh2.58million (US\$1.122). The country ranks 159 in the world in the United Nations Development Programme's Human Development Index, with a score of approximately 0.53.

Income levels are moderately distributed among the population, given a Gini coefficient of 40.5 in 2017. The country ranked 141 in terms of ease of doing business in 2020, with a score of 54.5. The country has experienced impressive GDP growth rates over the past decade averaging almost seven percent per year. The GDP grew by 4.6 percent in year 2022, higher than the growth of 4.3 in 2021, with the rate is projected to grow at approximately seven percent through year 2023.

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.

Figure 1: Map of Tanzania



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 2023 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 2022. 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.

## **1.1 Background of the Study**

Kisarawe District is located in the Coastal part of Tanzania, having an area of about 3,535Km<sup>2</sup>, situated between DMS latitude longitude coordinates 6°54'0"S, 39°4'0.01"E. It is one of 8 Administrative Districts in the Pwani Region, 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 Kisarawe District. The recent survey indicates, clay deposit in Kisarawe may cover approximately 115.7959km<sup>2</sup> extending from Mambisi, Vibura area to Bwama, Marui mipera and Yombo Lukinga Villages. One clay brick factory KIBRICO were within this area.

## **1.2 Objectives of the Pre-feasibility Study**

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.

## **1.3 Scope of Study**

The Terms of Reference (ToR) 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.

#### **1.4 Methodology**

This feasibility study 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 Kisarawe 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 Kisarawe district council and other key stakeholders.

## **2. Market Analysis**

### **2.1 Overview of the construction industry in Tanzania**

Tanzania's construction industry comprises both the Constructing Firms and the Raw Materials Providers. The Constructing Firm base is characterized by a large number of micro-entrepreneurs, the majority of whom operate in the country's informal economy. The country's formal construction sector comprises of indigenous and indigenized firms, as well as numerous major foreign civil engineering and construction companies.

As an industry with linkages to all sectors of the economy, the construction sector performs a pivotal role in Tanzania, as well as across the East African trade bloc. According to the Tanzania National Bureau of Statistics, the market value of the construction sector at current prices increased from approximately US\$ 6.6bn in 2016 to more than US\$9bn in 2022.

Apart from infrastructure development projects, of growing importance is the demand for housing and other social infrastructures. Tanzania's substantial housing backlog is estimated to exceed 3 million residential units and annual demand for housing is in the region of 200,000 units.

This is most exciting sector in Tanzania, currently growing at 13%; creating high demand for building materials.

- ✚ There's estimated 3 million units' shortage of housing in Tanzania (according to National Construction Council-NCC).
- ✚ Demand for Housing is growing at a rate of 200,000 units per year.
- ✚ Tanzania Building Agency, TBA, established to cater for quality and affordable houses for Government and Civil servants needs 350,000 houses and currently plans to build about 20,000 new houses come 2025.
- ✚ The National Housing Corporation plans to build 50,000 houses for sale and lease by June 2025,
- ✚ Currently housing construction activities use cement, and there are 8 cement factories in Dar es Salaam, Tanga, Mtwara and Mbeya region, however, all do meet the national market demand.
- ✚ Few individuals use Clay bricks for houses prepared locally using traditional ways to burn, approximately 50 million clay bricks per annual.

- ✚ Low Cost Houses in Tanzania can only be done through using face bricks (according to National Housing & Building Research Agency-NHBRA).

## **2.2 Construction Materials and Equipment**

The manufacturing and supply of local construction materials, such as cement, reinforcement steel, paints, ready-mixed concrete, and roofing materials, have been on the rise in Tanzania. The country has five big cement factories: Twiga Cement Factory, Tanga Cement Company Ltd, Tanzania Portland Cement Company Ltd, Mbeya Cement Company Ltd, and Dangote Cement Plc. The fairly recent increase in the number of big cement players in the local market seems to be responsible for the country's stable cement prices. In 2023, a 50kg bag of cement was sold at US\$8.5 in Tanzania, high above the price in neighbouring Kenya and Uganda where it is US\$8 and US\$7.5, respectively (CAHF, 2022).

While there are big companies supplying other construction materials locally, the country is a net importer of construction materials and machinery (Deloitte 2016), mainly from China, which accounts for more than a third of the total imports (34 per cent), followed by India and South Africa with 14 and 5 per cent, respectively. The challenge of locally available and imported building materials in Tanzania is that of quality. Most of the construction materials on the market, both manufactured and imported, are expected to be of substandard quality. Companies that hire equipment and/or plant machinery in Tanzania include: EFFCO Solutions (T) Limited, Kays Logistics Company Ltd, Torya Machinery Ltd, Armani Investment Limited, and CMTL Logistics. In addition, Mantrac Tanzania Ltd is the sole authorized dealer of CAT construction equipment in Tanzania. It is evident that the availability of construction equipment has been improving, with more companies investing in the hiring and supply of new and used construction equipment. However, contractors are constrained by inadequate capital to acquire such equipment and/or plant. Muhegi and Malongo (2004) mention that contractors face several challenges related to equipment and machinery when budgeting for and delivering projects. For example, there is a limited/small capital base and, usually, not readily available equipment or high hire rates.

Interviews with contractors, clients, and consultants undertaken in 2018 reveal challenges associated with construction materials and equipment (see Table 2). The challenges related to construction materials are high cost and low quality of imported materials and unavailability of locally produced materials. Similarly, challenges associated with equipment and/or plant are a lack of capital for acquisition, quality, and high cost of hiring.

**Table 3: Challenges associated with Construction material and Equipment**

S/N	Challenge	Remarks
1.	Local materials	Locally produced materials such as aggregates, sand, and gravel are not readily available in regions other than Dar es Salaam.
2.	Imported materials	Most materials are imported and there are few well established suppliers in Tanzania, which makes construction materials expensive.
3.	Quality of materials	The advancement of technology has brought about a variety of materials with no guarantee of quality.
4.	Unavailability of construction materials	Imported materials for specific projects such as railway line construction, mining, oil and gas are not readily available.
5.	Equipment and/or plant hire rates	Most plant hire companies are based in Dar es Salaam, they are not readily available in the regions and hire rates are higher than in Dar es Salaam by almost 40 per cent.
6.	Equipment owning	Most firms lack the capital to purchase the basic equipment needed for construction.
7.	Unavailability of equipment	Construction equipment is not readily available.

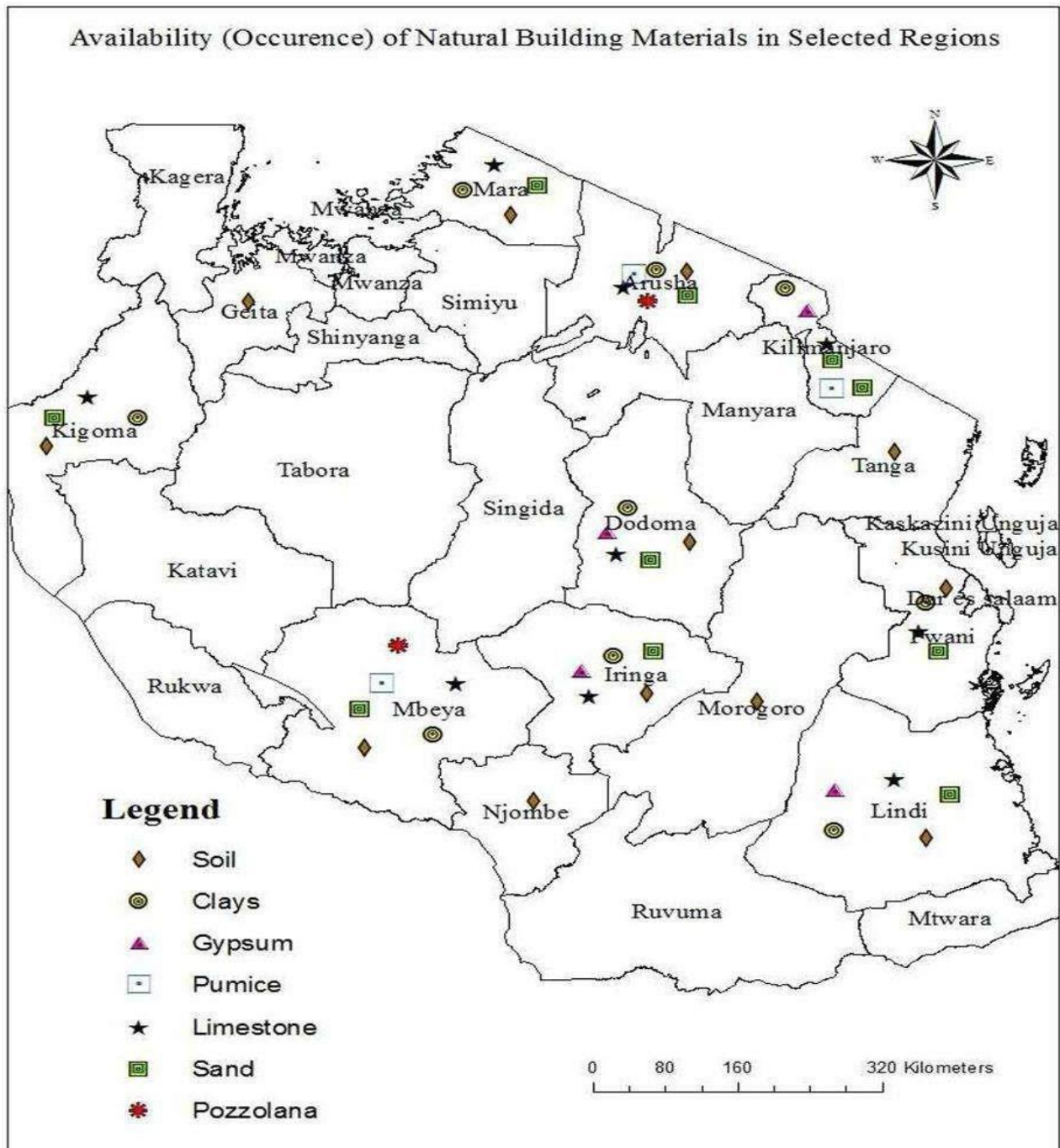
Source: Consultant, 2023

### 2.3 Building Material Resources availability in Tanzania

In Tanzania the main building material resources available includes soil, sand, clay, limestone, pumice, gypsum and pozzolana which are transformed into bricks, bricks to be used for construction of houses. Fig. 1 below presents the distribution of natural building materials used for housing construction. However, with reference to table 3 which presents the distribution of households by main materials used for housing construction, it shows that, people prefer clay 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 2: Building Materials in selected Regions



Source: Ardhi University, 2014

### Demand for Clay Bricks in Tanzania

Clay bricks have been known for centuries as one of the most sought-after and reliable construction materials for durable and decent houses. The history of clay bricks in Tanzania goes back to 1950s where Germans and Fransiscan Fathers from Italy started clay works in Kisarawe and Bihawana, producing clay bricks for their buildings.

Historical clay brick schools, hospitals and churches are seen in Dar es salam, Iringa and Dodoma regions. According to the International Development Research Centre, IDRC<sup>1</sup> based in Canada made it clear that one of the most promising building material among all other materials available locally applied for housing construction is the fired clay bricks.

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 enhance supply capacity, national competitiveness, local value-addition, avoid environmental damage, waste and inefficient energy use. The use of clay bricks makes possible to achieve all of the above mentioned factors.

Clay bricks can guarantee to build good quality houses quickly and at lower costs.

The demand for clay bricks in Tanzania remains significant due to various factors. Clay bricks are a fundamental building material in Tanzania's construction sector, primarily used in residential, commercial, and infrastructural projects. Several reasons contribute to the sustained demand for clay bricks in the country, such as;

- i) Traditional, Clay bricks have a long history of use in Tanzanian construction practices, with many builders and homeowners preferring them for their familiarity and proven performance. This cultural preference contributes to the sustained demand for clay bricks in the country.
- ii) Tanzania has abundant clay deposits, (Fig. 1) which serve as the primary raw material for brick manufacturing. The availability of locally sourced clay facilitates the production of clay bricks, reducing dependence on imported materials and lowering production costs.
- iii) Clay bricks are favored for their durability and strength, making them suitable for various construction applications in Tanzania's diverse environmental conditions.

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

Their resistance to weathering and environmental factors ensures long-term structural integrity, meeting the quality standards required for construction projects.

- iv) Tanzania is experiencing rapid urbanization, with a growing population and increasing urban infrastructure requirements. This trend fuels the demand for clay bricks as a primary building material for residential, commercial, and infrastructural projects.



**Table 4: 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	2021/22	2000/01	2007	2021/22	2000/01	2007	2021/22	2000/01	2007	2021/22
<b>Poles, branches, grass</b>	0.9	1.5	0.0	5.3	4.6	0.2	19.3	16.9	1.0	16.0	13.0	0.7
<b>Mud &amp; poles or stone</b>	5.2	4.7	2.5	13.1	10.9	11.9	21.8	22	31.1	19.4	18.2	23.6
<b>Mud only</b>	2.2	1.9	-	12.1	10.3	-	18.1	12.0	-	16.1	10.7	-
<b>Mud bricks</b>	3.2	1.3	0.3	30.8	22.6	19.0	23.5	26.4	31.0	23.3	23.2	24.7
<b>Baked or burnt bricks</b>	1.3	1.6	0.2	15.9	29.9	42.0	13.7	18.8	28.1	13.2	19.3	27.3
<b>Concrete, cement, stone</b>	87.2	88.3	96.9	22.4	20.7	25.8	3.0	3.1	5.0	11.5	14.8	20.9
<b>Other</b>	0.0	0.5	0.1	0.4	1.0	1.0	0.6	0.9	3.8	0.5	0.9	2.8
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

Source: NBS National Census, 2022



## **2.5 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 (table. 4), 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.

**Table 5: Clay Bricks Manufacturing Capacity in SADC member Countries**

<b>Countries</b>	<b>Bricks per year</b>	<b>Population</b>	<b>GDP (PPP) billion</b>	<b>Bricks per capita</b>	<b>Bricks/GDP per capital</b>
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
<b>Total</b>	<b>4,976,000,000</b>	<b>417,109,442</b>			

Source: Swisscontact, 2017

From table. 5 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.

**Table 6: 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, Tunnel, Scove, BTK	Wood, Coal, Saw Dust, Rice Husk, Agricultural waste,	50%	Charcoal, & Wood	40%	5%	55%
Mauritius	0	-	-	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%

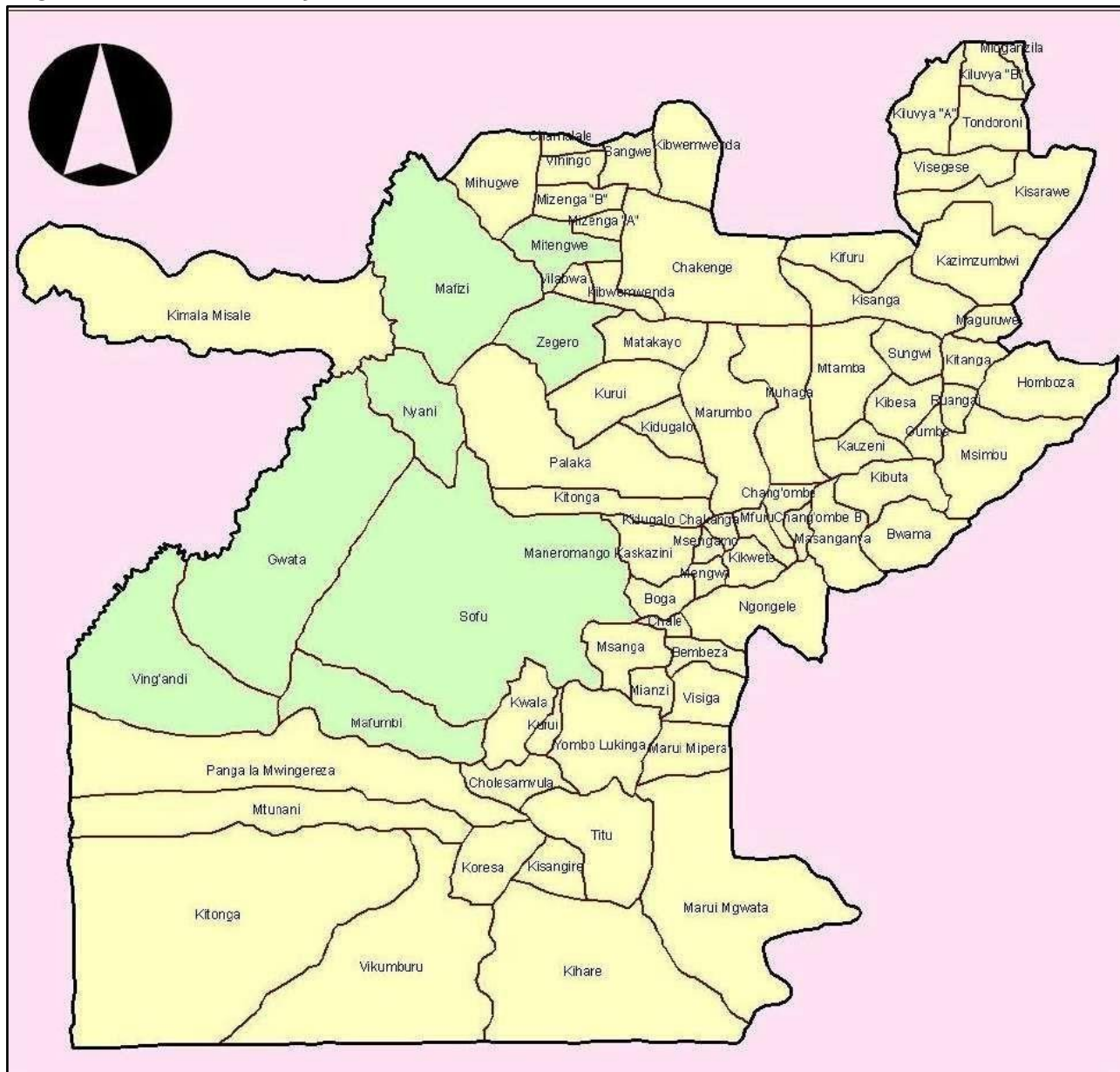
Source: Swisscontact, 2017

### 3. Location Description and Existing Environment

#### 3.1 Project Site

Kisarawe District is made of four administrative Divisions, Mzenga, Chole, Sungwi and Maneromango, comprised of 17 Wards with registered 66 villages. The Project site will be in one of four surveyed villages having abundant clay reserve with sound infrastructure system.

Figure 3: Kisarawe Project Location



Source: Kisarawe District Council, 2023

### 3.2 Climate, Topography, Vegetation and Drainage System

Kisarawe District experiences a tropical savanna climate, characterized by distinct wet and dry seasons. The wet season typically occurs from November to April, with the heaviest rainfall between March and May. During this time, temperatures are relatively high and humidity levels can be significant. The dry season, from May to October, sees reduced rainfall and cooler temperatures. However, even during the dry season, humidity remains relatively high due to the district's coastal proximity. **Topography:** The topography of Kisarawe District is varied, comprising coastal plains, low-lying hills, and some elevated areas. The district lies along the coastal belt of Tanzania, with its topography gradually rising from the coast towards the inland areas. The elevation ranges from sea level along the coast to several hundred meters inland. The landscape is generally characterized by gentle slopes, although there are some steeper areas, particularly towards the interior.

**Vegetation:** Kisarawe District reflects its diverse topography and climate. Along the coastal areas, mangrove forests and palm trees are common, adapted to the saline conditions and periodic inundation by tidal waters. Moving inland, the vegetation transitions to tropical savanna woodland, characterized by a mix of grasses, shrubs, and scattered trees such as acacias and baobabs. In higher elevated areas, where rainfall is relatively higher, there may be denser forests and thicker vegetation cover.

**Drainage:** The district's drainage system is influenced by its topography and rainfall patterns. Numerous small rivers and streams traverse the landscape, flowing from the inland hills towards the coast. These waterways play a crucial role in draining excess rainfall and maintaining the district's ecosystem. During the wet season, these rivers can swell, leading to localized flooding in low-lying areas. Additionally, there are seasonal wetlands and marshes that serve as important habitats for wildlife and contribute to the overall drainage network of the district.

**Hydrology:** Kisarawe District possesses a diverse hydrological system influenced by its topography, climate, and drainage patterns. Several key features characterize the hydrology of the district:

- ✚ **Rivers and Streams:** Kisarawe District is intersected by numerous small rivers and streams, most of which originate from the inland hills and flow towards the coast. These waterways provide vital sources of water for both human consumption and agricultural activities. During the rainy season, these rivers can swell, facilitating irrigation and replenishing groundwater reserves.

- ✚ **Groundwater:** Beneath the surface, Kisarawe District harbors significant groundwater resources. The permeable soils and geology of the region allow for the accumulation of groundwater in aquifers. Wells and boreholes are commonly used to access this groundwater for domestic use and agricultural irrigation, particularly during dry periods when surface water may be scarce.
- ✚ **Wetlands and Marshes:** The district is also characterized by seasonal wetlands and marshes, which play important roles in regulating water flow, filtering pollutants, and providing habitats for wildlife. These wetlands are particularly abundant in low-lying areas and serve as critical breeding grounds for various species of birds and aquatic organisms.
- ✚ **Coastal Dynamics:** Being located along the coast, Kisarawe District is influenced by coastal dynamics, including tidal fluctuations and erosion. Mangrove forests along the coastline serve as natural buffers against erosion and provide essential habitats for marine life. However, coastal erosion and sea-level rise pose challenges to coastal communities and infrastructure in the district.

**Table 7: Hydrogeology conditions and status in Kisarawe.**

S/N	Condition	Status
1.	General groundwater potential	Low to moderate
2.	Abstraction facilities	Boreholes, deep and shallow wells
3.	General water strike range	15-60 Meters
4.	Borehole depth	40-70 Meters
5.	Deep well depth	10-20 Meters
6.	Shallow well depth	<10 along river channels and low laying
7.	Areas	-
8.	Water level range	5-30 Meters
9.	General average yield	0.02-2.0 litres / second
10.	General water quality	Good for human consumption, crops etc.

Source: Consultant, 2023

**Soils:** The soil patterns in Kisarawe District exhibit variability influenced by factors such as topography, parent material, climate, and land use. Several soil types can be found in the district, including:

- ✚ **Alluvial Soils:** Found along riverbanks and floodplains, alluvial soils are fertile and well-suited for agriculture due to their high nutrient content and moisture retention properties. These soils are often used for growing crops such as rice, maize, and vegetables.
- ✚ **Sandy Soils:** Coastal areas and dune formations are characterized by sandy soils, which have low fertility and water-holding capacity. Agriculture in these areas may require irrigation and soil amendment practices to improve productivity.
- ✚ **Clay Soils:** Inland areas may have clay-rich soils derived from weathering of underlying bedrock. These soils tend to be more fertile but may suffer from drainage problems and compaction, particularly during heavy rainfall.
- ✚ **Lateritic Soils:** Some parts of Kisarawe District may have lateritic soils, characterized by their reddish coloration and high iron oxide content. These soils are relatively infertile and may require nutrient supplementation for agriculture.

Understanding the hydrology and soil patterns of Kisarawe District is essential for sustainable resource management and environmental conservation efforts, as during the investment time, drilling activities will largely be undertaken. Therefore, Local communities where clay brick project will take place need engagement to implement appropriate land use practices and conservation measures to mitigate potential challenges from these natural resources.

**Table 8: Soils properties**

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

Source: Consultant, 2023

### **3.3 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.

### **3.4 Social impact assessment**

The establishment of clay brick manufacturing activities may carry social effects to the population of Kisarawe. 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.

### **3.5 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.

### **3.6 Land Issues in Tanzania**

Tanzania has embarked on an industrial economy course which puts pressure on land governance. The Land Act 1999 provides for three categories of land: general, village, and reserved;

- ✚ **General land:** all public land which is not reserved land or village land and includes unoccupied or unused village land.

- ✚ **Village land:** as defined in the Village Land Act, 1999, is an area declared to be village land under and in accordance with Section 7 of the Act and includes any transfer or land transferred to a village.
- ✚ **Reserved land:** land reserved, designated, or set aside under the provisions of listed laws (Land Act 1999: Section.6); these include: environmental protection areas, such as national parks, forest reserves and wildlife reserves, including marine parks, and areas intended and set aside for spatial planning and future infrastructure.

General land is the category that is expected to be utilized by the construction sector for development. Land acquisition and registration is still a major problem in Tanzania. Kironde (2009) assessed land governance in the country and concluded that there were major challenges in registering land and improving land information systems, urban land management, and the management of public land, expropriation, and dispute resolution. Similarly, Mugabi (2013) highlights the challenges in land ownership in rural areas, which include: conflicts over land especially between farmers and livestock keepers; persistent land disputes resulting from the rapid expansion of towns encroaching on surrounding farming areas; tenure conflicts between customary and granted land rights; alienation of the people through accumulation of land by big national and multinational companies, leaving small-scale producers landless; absence of adequate and coordinated land information; and land insecurity among small landholder farmers, especially women.

### **3.7 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<sup>2</sup>. These estimates are provided by the District 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<sup>2</sup>. 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.

### **3.8 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.

### **3.9 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.

### **3.10 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 9) 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 9: 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
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 noisier 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 during operations the production is planned for the use of coal or 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 downstream farmers
1.13	Stream crossings?	Yes		The Kisarawe hills 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 Kisarawe 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 will increased incidences of HIV, AIDS, human traffic, sex harassment, child labor etc.

1.20	Loss of native species or genetic diversity?	No		
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	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?			
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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		
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	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 acidity 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	cost and loss of life to people

			Accident by trucks and mining equipment	
--	--	--	---	--

	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?			

Source: Consultant, 2023

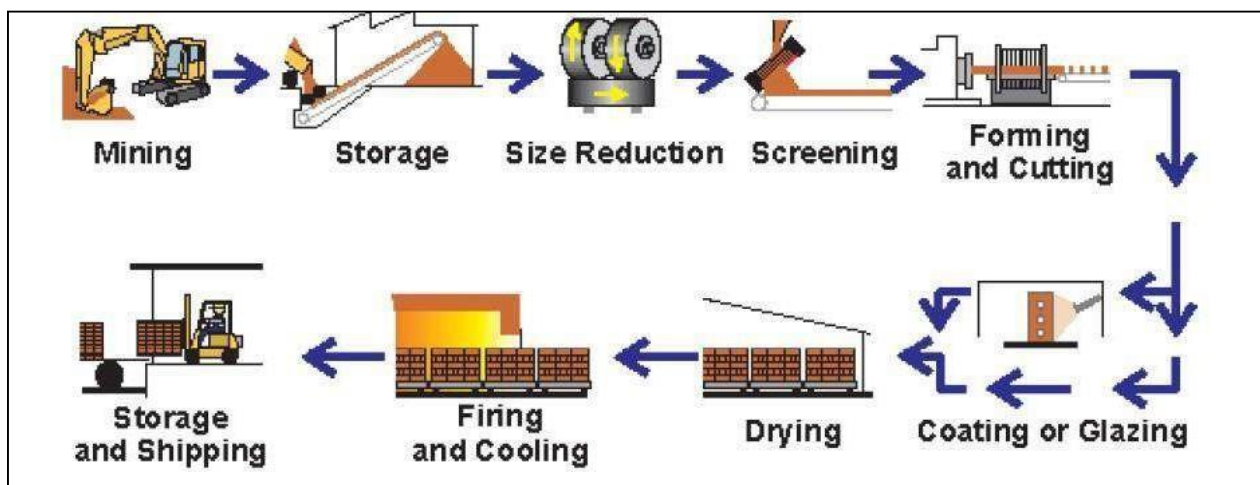
## 4. Technical Designs

### 4.1 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 4: Clay Brick Manufacturing Process



Source: Clay Brick Association of Southern Africa, 2021

### 4.2 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.

### 4.3 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.

#### **4.4 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. Sourcing ensures a homogenous mix improving the workability of the clay material, as well as providing a production buffer between the preparation and molding plants.

#### **4.5 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.

## **4.6 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.

## **4.7 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.

## **4.8 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.

## **4.9 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.

#### **4.10 Application of 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.

#### **4.11 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.

## **4.12 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<sub>2</sub> 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.

## **4.13 Production Technique**

### **4.1.3.1 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.

#### 4.1.3.2 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.

Automating the clay brick manufacturing process can significantly improve efficiency, save time, and reduce costs compared to manual-based processes. Here's an overview of how automation achieves these benefits:

**Material Handling:** Automated systems can handle raw materials such as clay, water, and additives more efficiently. Conveyor belts, robotic arms, or automated vehicles can transport materials from storage to mixing areas, reducing manual labor and streamlining the process.

**Mixing and Forming:** Automated mixers can precisely blend the ingredients in the correct proportions, ensuring consistency in brick quality. Once mixed, the clay is automatically fed into brick forming machines, which shape the clay into bricks using molds or extrusion processes. This eliminates the need for manual labor in mixing and forming, increasing production rates.

**Drying:** Automated drying chambers or tunnels can quickly and evenly dry the freshly formed bricks using controlled temperature and airflow. This reduces the drying time compared to traditional sun drying methods, allowing for faster production turnover and minimizing the risk of defects due to uneven drying.

**Firing:** In traditional brick manufacturing, firing kilns require careful monitoring and manual adjustments to achieve the desired temperature and duration. Automated kiln systems utilize sensors and programmable controls to precisely regulate the firing process, optimizing energy consumption and ensuring consistent brick quality.

**Quality Control:** Automated inspection systems can identify defects in the bricks, such as cracks or irregularities, using cameras and sensors. This allows for early detection and rejection of defective bricks, minimizing waste and improving overall product quality.

**Packaging and Transportation:** Once the bricks are ready, automated systems can handle packaging and palletizing tasks efficiently. Robotic arms or conveyor belts can stack bricks onto pallets according to predefined patterns, ready for transportation. This reduces manual labor requirements and ensures consistent packaging quality.

Overall, automating the manufacturing process offers numerous advantages, including increased production rates, improved product quality, reduced labor costs, and enhanced operational efficiency. By leveraging automation technologies, brick manufacturing stays competitive in the market while minimizing overhead costs and maximizing profits.

## 5. Financial Feasibility of the Project

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 at least 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.

### 5.1 Financial Analysis

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 G.
- ✚ 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 G.
- ✚ 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.

### 5.2 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

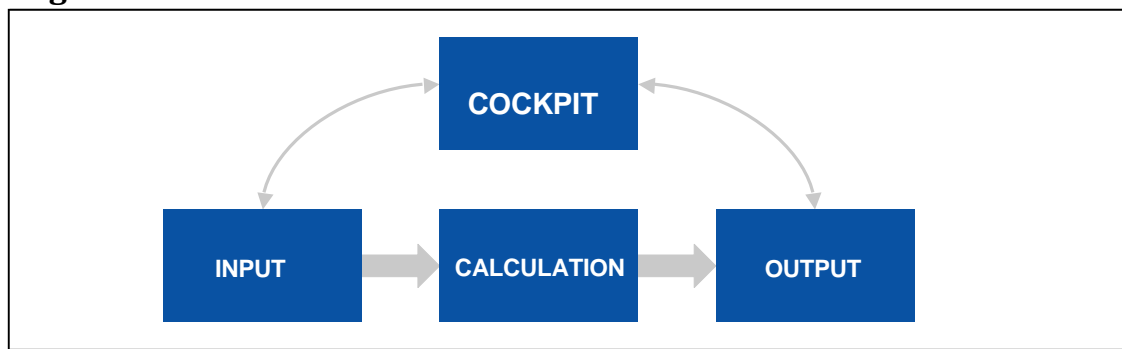
Assumptions made for the financial model are based on the:

- ✚ 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 September 2023 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.6 below

**Figure 5: Structure of the Model**



*Source: Makoro Consultant, 2023*

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 5.8](#) 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 price to 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.

### **5.3 Capital Expenditures**

Cost estimates are made for the following items:

- ✚ Land and clay mining (purchase) of max 1,000 hectare (about 2,471 acres);
- ✚ Relocation and resettlement of persons and objects;
- ✚ Brick Firing system; (Tunnel Kiln model)
- ✚ Road infrastructure: connection to the main railway, Central line and TAZARA line at Mzenga and Pugu Rail Station;
- ✚ Factory infrastructure (earth works, pavement, utilities, etc);
- ✚ Brick and tiles handling equipment (stackers, tractor trailers etc);
- ✚ Factory buildings, fences, etc;
- ✚ Furniture and fittings
- ✚ Motor vehicles

- ✚ Factory operations management system;
- ✚ Brick parking yard;
- ✚ Operating cost for the machine's 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.

- i) The Ward Executive Officer of Msanga Ward, indicated that the cost of land is on average USD 1,000 per acre in Kisarawe. This figure has been used to estimate the cost of land for the project site.
- ii) Relocation and compensation costs are based on findings in [section 3.7](#) being between USD 190-300 per m<sup>2</sup>. The population density of Bwama, Marui mipera and Yombo Lukinga area is limited and for calculation purposes the consultants have assumed a total compensation of some USD 300,000.

#### **5.4 Operational expenditures**

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

#### **5.5 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.

#### **5.6 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.

## 5.7 Financing

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 G.

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.

## 5.8 VAT and Other Taxes

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

## 5.9 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 47.9% For detailed calculation of the RoE required see Annex G.
- ✚ 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 9.95% For detailed calculation of the WACC see Annex G.
- ✚ 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.

## **6. Legal and Regulatory Framework**

The Tanzanian construction sector is made up of several government Ministries and its agencies, consultative body, regulatory boards and clients, suppliers of construction materials and equipment, consulting firms, construction enterprises, private firms, and professional associations. The housing construction sub-sector is regulated by several regulatory bodies, each responsible for overseeing different aspects of construction and ensuring compliance with relevant laws and standards. Here are some of the key regulatory bodies.

### **6.1 Government Ministries, Agencies and Regulatory Bodies**

#### **6.1.1 Ministry of Land, Housing and Human Settlements Development**

The Ministry of Lands, Housing, and Human Settlements Development is responsible for formulating and implementing policies and strategies related to land and housing administration, management, and development in Tanzania. The Ministry oversees land use planning, land registration, land tenure systems, and land dispute resolution. It provides guidance, technical support, and regulatory oversight to various stakeholders involved in the housing construction sector.

##### **6.1.1.1 National Housing Corporation**

The National Housing Corporation (NHC) is a government agency responsible for promoting and facilitating the provision of housing in Tanzania. NHC plays a crucial role in the development of housing projects, including affordable housing schemes and social housing initiatives. It oversees the planning, financing, and implementation of various housing projects across the country.

#### **6.1.2 Ministry of Works, Transport, and Communications**

The Ministry of Works, Transport, and Communications (MoWTC) is responsible for formulating and implementing policies related to infrastructure development and construction in Tanzania. The Ministry oversees the planning, design, and execution of housing and infrastructure projects, ensuring compliance with national development goals and standards. It plays a crucial role in promoting sustainable infrastructure system and ensuring equitable access the resources for social and economic development.

#### **6.1.2.1 Contractors Registration Board (CRB)**

The Contractors Registration Board (CRB) regulates the registration and licensing of construction contractors and consultants in Tanzania. It ensures that construction firms and professionals meet specific criteria regarding competence, financial capability, and adherence to ethical standards.

It oversees the registration process, classification of contractors, and enforcement of regulations governing construction activities.

#### **6.1.2.2 Engineers Registration Board (ERB)**

Engineers Registration Board is a statutory government body having a role in driving progress, innovation, and sustainable development. As the guardians of the engineering profession, the Board is dedicated to ensuring the highest standards of excellence and professionalism within construction industry.

#### **6.1.2.3 National Construction Council (NCC)**

The National Construction Council (NCC) is a consultative body responsible for promoting and providing strategic leadership for growth, development, and expansion of the construction sector, with an emphasis on the development of local capacity.

#### **6.1.2.4 Tanzania Building Agency (TBA)**

The Tanzania Building Agency (TBA) is tasked with coordinating and supervising public construction projects, including housing developments, on behalf of the government. This Agency manages the procurement process, contract administration, and quality control aspects of construction projects to ensure timely completion and adherence to standards.

It plays a crucial role in the implementation of government-funded housing initiatives and infrastructure projects across Tanzania.

#### **6.1.2.5 Architects and Quantity Surveyors Registration Board (AQRB)**

The AQRB, established by the Architects and Quantity Surveyors (Registration) Act No 16 of 1997, is responsible for registering and regulating the activities of architects, quantity surveyors, allied disciplines, and consulting firms.

### **6.1.3 Ministry of Industry and Trade**

The Ministry of Industry and Trade (MIT) is responsible for formulating and implementing policies and strategies related to industrial development, trade promotion, and market regulation in Tanzania. It facilitates business registration and licensing processes, promotes investment in manufacturing sector, and supports the growth of small and medium enterprises (SMEs).

MIT oversees trade agreements, tariffs, import/export regulations, and consumer protection measures to ensure fair and transparent trade practices.

#### **6.1.3.1 Tanzania Bureau of Standards (TBS)**

The Tanzania Bureau of Standards is mandated to develop and enforce quality standards for construction materials and processes, including those used in housing construction. TBS sets standards for various building materials, such as cement, steel, bricks, and roofing materials, to ensure safety, durability, and quality in construction projects.

It conducts testing and certification of construction materials to ensure compliance with established standards.

#### **6.1.4 Ministry of Minerals**

The Ministry of Minerals is responsible for formulating and implementing policies, laws, and regulations governing the mining sector in Tanzania. The ministry oversees mineral exploration, mining operations, licensing, and revenue collection, aiming to promote sustainable development, value addition, and local beneficiation in the mining industry.

It collaborates with other government agencies, mining companies, and stakeholders to ensure compliance with environmental, social, and fiscal regulations in the mining sector.

##### **6.1.4.1 Mining Commission**

The Mining Commission is a regulatory body established to oversee the implementation of mining laws and regulations in Tanzania. The Commission grants mining licenses, monitors mining activities, and enforces compliance with mining regulations to promote responsible mining practices and maximize the contribution of the mining sector to national development. The commission also facilitates geological surveys, data management, and capacity-building initiatives to support sustainable mining activities.

##### **6.1.4.2 Geological Survey of Tanzania (GST)**

The Geological Survey of Tanzania is responsible for geological research, mapping, and exploration activities aimed at identifying and assessing mineral resources in Tanzania. GST provides geological information, data, and technical support to government agencies, investors, and stakeholders involved in mineral exploration and mining activities.

It conducts geological surveys, mineral prospecting, and resource assessments to promote informed decision-making and sustainable utilization of mineral resources.

### **6.1.5 Ministry of Energy**

Ministry of Energy is mandated to formulate and monitor implementation of Policies on Energy, Oil and Gas. The Ministry is responsible for Energy and Petroleum Resource Management; Value addition in Petroleum; Oil and Gas Infrastructure Development; Bulk Procurement of Oil; Urban and Rural Electricity Programmes; Local Content in Energy and Petroleum; Renewable and Non-Renewable Sources of Energy; Performance Improvement and Development of Human Resources; Extra-Ministerial Departments, Parastatal Organisations, Agencies, Programmes and Projects under this ministry.

#### **6.1.5.1 Energy and Water Utilities Regulatory Authority (EWURA)**

The Energy and Water Utilities Regulatory Authority is responsible for regulating the electricity, natural gas, and water sectors in Tanzania. EWURA sets tariffs, licenses operators, and monitors the performance of energy and water utilities to ensure efficiency, affordability, and quality of service.

It promotes competition, consumer protection, and investment in the energy and water sectors to enhance access to reliable and sustainable energy and water services.

#### **6.1.5.2 Rural Energy Agency (REA)**

The Rural Energy Agency is mandated to promote and facilitate rural electrification and renewable energy development in Tanzania. REA implements rural electrification projects, facilitates investment in renewable energy technologies, and supports off-grid and mini-grid electrification initiatives in rural areas.

It collaborates with government agencies, development partners, and private sector stakeholders to expand energy access and improve livelihoods in rural communities.

#### **6.1.5.3 Tanzania Petroleum Development Corporation (TPDC)**

The Tanzania Petroleum Development Corporation is the national oil and gas company responsible for managing and developing petroleum resources in Tanzania. TPDC participates in upstream activities, including exploration, production, and development of oil and gas fields, in collaboration with international oil companies.

It promotes local content development, oversees licensing and regulatory compliance, and implements policies to maximize the socio-economic benefits of the oil and gas sector for Tanzania.

### **6.1.6 National Environment Management Council (NEMC)**

NEMC was established with a broad mandate in response to the national need for such an institution to oversee environmental management issues and also implement the global resolutions concerning the environments and conservation declarations, which require all nations to on environmental issues. NEMC therefore, is a public service institution whose business is the conservation of the environment for improved quality of life of Tanzanian people. NEMC under the Vice President's Office is mandated to spearhead programs related to environmental and resources protection, conservation and management.

On this context, NEMC undertakes to monitor the Environmental and Social Impact Assessment (ESIA) exercise for all projects in the country and issues a certificate of clearance.

All these regulatory bodies above, work collaboratively to promote sustainable and compliant housing construction practices in Tanzania, ensuring the delivery of safe, affordable, and quality housing for the population.

## **7. Conclusion and Recommendations**

### **7.1 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, Yombo Lukinga was considered the best site for clay brick factory due to its terrain structure which is much better geo-technically structured compared to other surveyed sites in Kisarawe district. The planned industrial development area at Yombo Lukinga is attractive from a logistical point of view as well as terrain structure (narrowly shaped and hilly) point of view.
- ✚ The Yombo Lukinga 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.

### **7.2 Recommendations**

Based on the above conclusions the consultants recommend to:

- ✚ Initiate and proceed with investigations (cadastral survey) on land ownership at identified 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 Kisarawe 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 Yombo Lukinga village and Marui Mipera 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 joint venture, or PPP after a full economic feasibility study has been undertaken.

# **Annexure**

## **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 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 financier 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:

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

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. This 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 deductible. 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 30 percent and equity to capital is proposed to be 70 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:<sup>1</sup>

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

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<sup>1</sup> 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](#)<sup>3</sup> As published by the US Treasury Department.

$k_d$  = 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.

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 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:

- The AON Political & Economic Risk Map<sup>2</sup>, 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.

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<sup>2</sup> [http://www.aon.com/risk-services/political-risk-map/images/2009\\_PE\\_Risk\\_Map\\_Small.pdf](http://www.aon.com/risk-services/political-risk-map/images/2009_PE_Risk_Map_Small.pdf)

### *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.

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

$k_e$  = cost of equity  $r_f$  = risk free rate of return  $\beta_E$  =

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 ( $\beta_E$ ), which, in turn, is a function of both asset risk ( $\beta_A$ ) 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:<sup>3</sup>

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

$k_e$  = cost of equity  $r_f$  = risk free rate of return  $\beta_E$  =

equity beta

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

CRP = country risk premium

SRP - Size Risk Premium

### *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,<sup>4</sup> set to 4.0%.

### *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 known 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 ( $\beta_E$ ). For a publicly traded company,  $\beta_E$  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;

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<sup>3</sup> The real cost of capital. Chapter 6: International WACC and country risk on [http://www.costofcapital.net/Chapter6%20-](http://www.costofcapital.net/Chapter6%20-%20Country%20Risk%20(25-07-04).doc)

[%20Country%20Risk%20\(25-07-04\).doc](http://www.costofcapital.net/Chapter6%20-%20Country%20Risk%20(25-07-04).doc)

<sup>4</sup> In accordance with finance expert Prof. Damodaran (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/>

- Calculation of each peer company's asset beta ( $\beta_A$ ) 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

$\beta_E$  = equity beta

$\beta_A$  = asset beta

## ANNEX D: Clay Raw material chemical test reference for Clay brick production

For basic performance of raw material, please take below for reference.

Basic parameters		Require degree	Common brick
Name	Item		
Chemical composition	SiO <sub>2</sub> (%)	Proper Allow	55-70 45-80
	Fe <sub>2</sub> O <sub>3</sub> (%)	Proper Allow	2-10 3-15
	Al <sub>2</sub> O <sub>3</sub> (%)	Proper Allow	10-25 5-30
	CaO(%) MgO(%) SO <sub>3</sub> (%) Loss on ignition	Allow Allow Allow Allow	0-15 0-5 0-3 3-15
Plasticity	Plasticity index	Proper Allow	9-13 5-17
Shrinkage percentage	Firing shrinkage	Allow Allow	3-8 2-5
Drying sensitivity	Sensitive coefficient	Proper Allow	<1 <2
Sinter property	Firing temperature(°C)	Proper	950-1150
Else	Natural water(%) content (t/m <sup>3</sup> )natural volume		Molding moisture content≤

### Clay depositories

Clay, mined from the quarry should be subjected to primary processing: left for mature into an open-air pile. At the same time maturing must be at least 6 months. Research in this area and extensive practical experience in the industries have shown that an increase in maturing time has a positive effect on the properties of clay and, as a consequence, the properties of finished products. Practice has shown that this increases the clay plasticity and molding properties are greatly increased mass, which in turn leads to higher quality finished products.

For year-round operation of the plant is a must Clay depository. Its main function is to back-up and protection of raw materials on the climatic conditions (rain, snow, low and high temperature, etc.). Area Clay depositories depend on the performance of the plant and on the region's climate. Usually it is calculated on 3-4 months of continuous operation of the plant.

**Branch of the stock preparation**

To obtain high-quality brick raw materials requires careful processing. It is necessary in processing of clay to provide it in effects on different planes. Clay, passing through stock preparation line technology tests following grinding methods: impact, crushing, abrasion, bending, cutting, etc.

In many cases, for high-quality bricks of the main raw material - clay (loam) is not enough, so there are different types of additives for enrichment of clay or use several kinds of clay. the following additives may be used: plasticizers (clay with a large number of plasticity), sand, fire clay, sawdust, waste coal,

**ANNEX E: SOIL TEST REPORT- (XRF) TIRDO (by %)**

<b>ELEMENT</b>	<b>SAMPLE ID: A MARUMBO</b>	<b>SAMPLE ID: B YOMBO LUKINGA</b>	<b>SAMPLE ID: C MALUI</b>	<b>SAMPLE ID: D BWAMA</b>
Alumina- Al <sub>2</sub> O <sub>3</sub>	9.96	16.59	9.05	16.40
Silica- SiO <sub>2</sub>	45.45	61.90	43.57	64.41
Lime- Ca <sup>0</sup>	10.35	0.38	13.14	0.72
Iron oxide- Fe <sub>2</sub> O <sub>3</sub>	4.75	5.28	6.63	6.46
Magnesia Mg <sup>0</sup>	2.01	0.02	2.52	0.02
Sulphur- S	-	-	-	0.09
Phosphorus- S	-	-	-	0.10
Potassium- K	-	-	-	0.57
Titanium -Ti	-	-	-	0.49
Barium- Ba	-	-	-	0.12
Chromium- Cr	-	-	-	0.03
Copper- Cu	-	-	-	0.05

**ANNEX F: X- RAY DIFRACTION (X-RD) ANALYSIS REPORT (GST) (by %)**

<b>ELEMENT</b>	<b>SAMPLE ID: A MARUMBO</b>	<b>SAMPLE ID: B YOMBO LUKINGA</b>	<b>SAMPLE ID: C MALUI</b>	<b>SAMPLE ID: D BWAMA</b>
Quarts	4.6	47.5	36.7	63.2
Kaolinite	20.4	16.0	-	14.8
Diakite	24.2	19.8	-	13.1
Tridymite	8.9	-	-	-
Laumontite	4.6	-	-	-
Chabarite	0.3	-	-	-
Magnetite	-	0.9	-	-
Albite	-	13.4	5.2	-
Titanite	-	-	2.3	-
Geoethite	-	2.4	6.8	6.8
Brucite	-	-	5.5	-
Muscovite	-	-	27.9	1.3
Montmorillonite	-	-	-	0.7
Chlorite	-	-	-	-
Illete	-	-	-	-

**X RF ANALYLISIS REPORT (GST) by %**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
Silica	58.18	58.57	65.33	64
Alumina	23.66	12.28	17.42	-
Lime	0.11	5.24	0.11	-
Iron oxide	2.11	4.88	4.68	-
Magnesia (Mg <sub>o</sub> )	0.42	0.49	0.38	-

## ANNEX G: Financial Projections

Nyambari Nyangwine Resources Tanzania Ltd								Annex 1.1	
<b>Clay/Kaoline Bricks Manufacturing Project-Kisarawe District</b>									
<b>TZS/USD Exchange rate</b>									
Oanda FX exchange rate (26.02.2024)						0.00039			
<b>EURO/USD Exchange rate</b>									
Oanda FX exchange rate (26.02.2024)						1.10133			
<b>Investment Capital Items Cost Estimates (ICICE)</b>									
<b>1. Land and clay-kaoline pit</b>						<b>Size: M²</b>	<b>USD</b>	<b>Total cost: USD</b>	
Total land concession		Km. Sq. 6				6,000,000	0.09035	542,100	
Sub total								542,100	
Add: Contingency						3.00%		16,263	
<b>Total: Land concession</b>								<b>558,363</b>	
<b>2. Buildings</b>									
<b>2.1 Factory buildings</b>									
(a) Blg for brick making plant & machinery (SABO SA)						3,000	413	1,238,532	
(b) Blg for tunnel drier (SABO SA)						4,500	413	1,857,798	
(c) Blg for tunnel kiln (SABO SA)						6,000	413	2,477,064	
<b>2.2 Other building(s)</b>									
- Admin Offices, staff services, e.g. lockers, showers & dining room (Local Supplier)						500	550	275,229	
Sub total								5,848,624	
Add: Contingency						3.20%		187,156	
<b>Total: Buildings</b>								<b>6,035,780</b>	
<b>3. Plant &amp; Equipment (P &amp; E)</b>									
3.1 Clay-Kaolin - brick manufacturing machinery (SABO SA)				Euro		10,678,035.00		11,760,040	
3.2 Others - e.g. raw material handling equipment e.g. mining excavators & tippers								2,697,307	
Sub total								14,457,347	
Add: Cost of installation of machinery (DSA <sup>1</sup> @USD 100 of 10 people for 90 days & cost of RAT <sup>2</sup> )								200,000	
Add: Contingency						2.90%		425,063	
<b>Total: Plant and Equipment</b>								<b>15,082,410</b>	
<b>4. Office and such other related equipment</b>									
Various						Lumpsum		100,000	
Add: Contingency						3.20%		3,200	
<b>Total: Office equipment</b>								<b>103,200</b>	
<b>5. Furniture and fittings</b>									
Various						Lumpsum		100,000	
Add: Contingency						3.20%		3,200	
<b>Total: Furniture and fittings</b>								<b>103,200</b>	
<b>6. Motor vehicles - for office</b>									
Various						Lumpsum		100,000	
Add: Contingency						3.20%		3,200	
<b>Total: Motor vehicles</b>								<b>103,200</b>	
<b>Total Fixed Investment Capital Items Cost Estimates (FICICE)</b>								<b>21,986,153</b>	
NB.									
DSA <sup>1</sup>		means Daily Subsistence Allowance							
RAT <sup>2</sup>		means Return Air Ticket							

Nyambari Nyangwine Resources Tanzania Ltd							Annex 1.2	
Clay/Kaoline Bricks Manufacturing Project-Kisarawe District								
Investment Capital Items Cost Estimates (ICICE)								
7. Pre-Operating Expenses (POE)							Total Cost: USD	
7.1 Initial Project Preparation Costs (IPPC) - see Annex 1							589,401	
7.2 Fund mobilisation								
Assumption:								
(1) Afreximbank loan for IPPC - amount as a % of IPPC					70%	USD	412,580.94	
Loan interest p.a.							3.50%	
Facility fees							0.25%	
Tenor after start of commercial operations							Months	72
Repayment Monthly in arrears w.e.f. end of 1st month of start of project's commercial productions operations								
Loan interest during Project's F Study (PFS) and physical implementation is capitalised on simple interest basis							4,813	
PFS is carried out over a period of							Months	4
Loan is disbursed in two instalments - 50% at start of carrying out the PSF & 55% at beginning of 3rd month of carrying out the PFS								
(2) Long-term loan for funding project's ICICE - amount as a % of FICICE					70%	USD	15,390,307	
(a) Facility fees - as a % of loan amount							0.25%	
(b) Legal fees - as a % of loan amount							0.25%	
(c) Fund mobilisation fees (Success fee) - as % of loan amount for FICICE							0.25%	
(d) Tenor after start of commercial operations							Months	72
e								
7.3 Loan Interest During Project's Physical Implementation (LIDPPI)								
Assumptions:								
(a) Project physical implementation period is 1 year (12 months)								
(b) Loan Interest rate p.a.							3.50%	
(c) Loan is disbursed at beginning of each quarter during project's physical implementation as under:								
Loan	Disbursement	loan	loan	amount	loan	Implementation (LIDPPI)		Total LIDPPI
1	1	Bld constn	25.00%	3,847,577	3,847,577	11,222		11,222
2	2				3,847,577	11,222		11,222
	3				3,847,577	11,222		11,222
	4	and order of	25%	3,847,577	7,695,154		22,444	22,444
	5				7,695,154		22,444	22,444
	6				7,695,154		22,444	22,444
3	7	and other	25.00%	3,847,577	11,542,730		33,666	33,666
	8				11,542,730		33,666	33,666
	9				11,542,730		33,666	33,666
4	10	Various ICICES	25.00%	3,847,577	15,390,307	-		44,888
	11				15,390,307	-		44,888
	12				15,390,307	-		44,888
		Total	100.00%	15,390,307				336,663
5.4 Project Management fees as a % of FICICE								
							0.50%	
							109,931	
<b>Total: Pre-Operating Expenses</b>							<b>1,244,877</b>	

Capital Investment Items Cost Estimates (CIICE)							Annex 1.3
<b>Summary of Capital Investment Items Cost Estimates</b>							<b>Total Cost: USD</b>
<b>(1) Investment Capital Items</b>							
Land and clay pits							558,363
Buildings							6,035,780
Plant and equipment							15,082,410
Office equipment							103,200
Furniture and fittings							103,200
Motor vehicles							103,200
Pre-Operating Expenses							1,244,877
<b>Sub Total</b>							<b>23,231,030</b>
<b>Add:</b>							
<b>(2) Initial Working Capital</b>							
Initial working capital							<b>809,799</b>
<b>Total: Capital Investment Items Cost Estimates</b>							<b>24,040,829</b>
<b>Proposed Financing plan</b>							
<b>funds</b>				<b>Proportion-</b>		<b>Average Cost</b>	<b>Total Cost: USD</b>
Equity				30.00%		7.500%	8,233,128
Loan				70.00%		2.4500%	15,807,702
<b>Total</b>				<b>100.00%</b>		<b>9.95%</b>	<b>24,040,829</b>

Nyambari Nyangwine Resources Tanzania Ltd										Annex 2		
<b>Clay/Kaoline Bricks Manufacturing Project-Kisarawe District</b>												
<b>Revenue assumptions</b>												
<b>1. Products</b>												
(a) Product/Type of bricks					Hollow/Solid							
(b)Dimensions of bricks - All in mm:			Length	Width	Height	Weight-kg						
			420	330	60	4.5						
<b>2. Production capacity</b>												
2.1 Working days per annum						300						
2.2 Plant capacity utilization (PCU)												
(a) Rated Machine production capacity - no. of bricks per day						500,000						
(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												
<b>Year</b>					<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
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'	120,000	132,000	145,200	145,200	145,200	145,200	145,200	145,200
4. Annual revenues												
4.1 Inflationary index												
Annual inflation				3.00%								
Inflationary index				1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23	
4.2 Selling price per brick			USD	0.28								
<b>Annual Sales Revenue from sale of bricks</b>				<b>USD:</b>	<b>33,600,000</b>	<b>38,068,800</b>	<b>43,131,950</b>	<b>44,425,909</b>	<b>45,758,686</b>	<b>47,131,447</b>	<b>48,545,390</b>	<b>50,001,752</b>

Nyambari Nyangwine Resources Tanzania Ltd											Annex 3.1	
Clay/Kaoline Bricks Manufacturing Project-Kisarawe District												
Operating cost assumptions												
Year					1	2	3	4	5	6	7	8
<b>1. Inflationary index</b>												
Annual inflation			3.00%									
Inflationary index					1.00	1.03	1.06	1.09	1.13	1.16	1.19	1.23
<b>2. Total number of bricks produced annually</b>				Pcs: '000'	120,000	132,000	145,200	145,200	145,200	145,200	145,200	145,200
<b>3. Direct operating costs (DOC)</b>		<b>Qty/brick</b>	<b>Cost/4.5 kg brick: USD</b>									
Clay @ kg		4.50	0.03	USD:	3,600,000	4,078,800	4,621,280	4,759,919	4,902,716	5,049,798	5,201,292	5,357,331
Fuel/coal @ m <sup>3</sup>		0.000100	0.0000108	USD:	1,296	1,468	1,664	1,714	1,765	1,818	1,872	1,929
Water @ m <sup>3</sup>		0.0005	0.0001996	USD:	23,949	27,134	30,743	31,665	32,615	33,594	34,602	35,640
Electricity @ kwh		0.1400	0.006	USD:	664,200	752,539	852,626	878,205	904,551	931,688	959,638	988,427
Labour		0.0012	0.006	USD:	664,200	752,539	852,626	878,205	904,551	931,688	959,638	988,427
Others		0.0133	0.06	USD:	7,200,000	8,157,600	9,242,561	9,519,838	9,805,433	10,099,596	10,402,584	10,714,661
<b>Total</b>				<b>USD:</b>	<b>12,153,645</b>	<b>13,770,080</b>	<b>15,601,500</b>	<b>16,069,546</b>	<b>16,551,632</b>	<b>17,048,181</b>	<b>17,559,626</b>	<b>18,086,415</b>
<b>4. Indirect operating expenses</b>			<b>As a % of Revenue</b>									
Administration			18.00%	USD:	6,048,000	6,852,384	7,763,751	7,996,664	8,236,564	8,483,660	8,738,170	9,000,315
Utilities-other than that of manufacturing			1.50%	USD:	504,000	571,032	646,979	666,389	686,380	706,972	728,181	750,026
Marketing			2.00%	USD:	672,000	761,376	862,639	888,518	915,174	942,629	970,908	1,000,035
Repair and maintenance - Non-Manufg			1.00%	USD:	336,000	380,688	431,320	444,259	457,587	471,314	485,454	500,018
Financial - other than that of loan interest			0.25%	USD:	84,000	95,172	107,830	111,065	114,397	117,829	121,363	125,004
<b>Total</b>			<b>22.75%</b>	<b>USD:</b>	<b>7,644,000</b>	<b>8,660,652</b>	<b>9,812,519</b>	<b>10,106,894</b>	<b>10,410,101</b>	<b>10,722,404</b>	<b>11,044,076</b>	<b>11,375,399</b>
<b>5. Working capital schedule</b>											<b>USD</b>	
Item	Basis	Period	Number									
<b>Stocks</b>												
Raw materials	Cost of Clay/Kaolin	Month	0.25		-	-	-	-	-	-	-	-
Work in progress	DOC	Month	0.25		253,200.94	286,877	325,031	334,782	344,826	355,170	365,826	376,800
Finished goods	DOC	Month	0.5		506,402	573,753	650,063	669,564	689,651	710,341	731,651	753,601
Packing materials	DOC - Others	Month	0.5		300,000	339,900	385,107	396,660	408,560	420,816	433,441	446,444
<b>Total</b>					<b>1,059,603</b>	<b>1,200,530</b>	<b>1,360,200</b>	<b>1,401,006</b>	<b>1,443,037</b>	<b>1,486,328</b>	<b>1,530,918</b>	<b>1,576,845</b>
<b>Debtors</b>	Sales Revenues	Month	0.5		<b>1,400,000</b>	<b>1,586,200</b>	<b>1,797,165</b>	<b>1,851,080</b>	<b>1,906,612</b>	<b>1,963,810</b>	<b>2,022,725</b>	<b>2,083,406</b>
<b>Total Stocks and Debtors</b>					<b>2,459,603</b>	<b>2,786,730</b>	<b>3,157,365</b>	<b>3,252,086</b>	<b>3,349,649</b>	<b>3,450,138</b>	<b>3,553,642</b>	<b>3,660,251</b>
<b>Less: Creditors</b>												
Direct operating costs		Month	1		1,012,804	1,147,507	1,300,125	1,339,129	1,379,303	1,420,682	1,463,302	1,507,201
Indirect operating costs		Month	1		637,000	721,721	817,710	842,241	867,508	893,534	920,340	947,950
<b>Total</b>					<b>1,649,804</b>	<b>1,869,228</b>	<b>2,117,835</b>	<b>2,181,370</b>	<b>2,246,811</b>	<b>2,314,215</b>	<b>2,383,642</b>	<b>2,455,151</b>
<b>Working capital</b>					<b>809,799</b>	<b>917,502</b>	<b>1,039,530</b>	<b>1,070,716</b>	<b>1,102,838</b>	<b>1,135,923</b>	<b>1,170,000</b>	<b>1,205,100</b>
<b>Change in Working capital</b>					<b>809,799</b>	<b>107,703</b>	<b>122,028</b>	<b>31,186</b>	<b>32,121</b>	<b>33,085</b>	<b>34,078</b>	<b>35,100</b>

Operating cost assumptions													Annex 3.2
Year						1	2	3	4	5	6	7	8
<b>6. Depreciation schedule</b>													<b>USD</b>
<b>Gross Fixed Assets</b>													
Land						558,363	558,363	558,363	558,363	558,363	558,363	558,363	558,363
Buildings						6,035,780	6,035,780	6,035,780	6,035,780	6,035,780	6,035,780	6,035,780	6,035,780
Plant and equipment						15,082,410	15,082,410	15,082,410	15,082,410	15,082,410	15,082,410	15,082,410	15,082,410
Office equipment						103,200	103,200	103,200	103,200	103,200	103,200	103,200	103,200
Furniture and fittings						103,200	103,200	103,200	103,200	103,200	103,200	103,200	103,200
Motor vehicles						103,200	103,200	103,200	215,969	215,969	215,969	215,969	215,969
Pre-Operating Expenses						1,244,877	1,244,877	1,244,877	1,244,877	1,244,877	1,244,877	1,244,877	1,244,877
<b>Total</b>						<b>23,231,030</b>	<b>23,231,030</b>	<b>23,231,030</b>	<b>23,343,800</b>	<b>23,343,800</b>	<b>23,343,800</b>	<b>23,343,800</b>	<b>23,343,800</b>
<b>Annual Depreciation</b>				<b>Method</b>	<b>Rate - %</b>								
Land				Straight line	0.00%	-	-	-	-	-	-	-	-
Buildings				Straight line	4.00%	241,431	241,431	241,431	241,431	241,431	241,431	241,431	241,431
Plant and equipment				Straight line	12.50%	1,885,301	1,885,301	1,885,301	1,885,301	1,885,301	1,885,301	1,885,301	1,885,301
Office equipment				Straight line	12.50%	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Furniture and fittings				Straight line	12.50%	12,900	12,900	12,900	12,900	12,900	12,900	12,900	12,900
Motor vehicles				Straight line	25.00%	25,800	25,800	25,800	25,800	28,192	28,192	28,192	28,192
Pre-Operating Expenses				Straight line	20.00%	248,975	248,975	248,975	248,975	248,975	-	-	-
<b>Total</b>						<b>2,427,308</b>	<b>2,427,308</b>	<b>2,427,308</b>	<b>2,427,308</b>	<b>2,429,700</b>	<b>2,180,725</b>	<b>2,180,725</b>	<b>2,180,725</b>
<b>Accumulated Depreciation</b>													
Land						-	-	-	-	-	-	-	-
Buildings						241,431	482,862	724,294	965,725	1,207,156	1,448,587	1,690,018	1,931,450
Plant and equipment						1,885,301	3,770,603	5,655,904	7,541,205	9,426,506	11,311,808	13,197,109	15,082,410
Office equipment						12,900	25,800	38,700	51,600	64,500	77,400	90,300	103,200
Furniture and fittings						12,900	25,800	38,700	51,600	64,500	77,400	90,300	103,200
Motor vehicles						25,800	51,600	77,400	103,200	131,392	159,585	187,777	215,969
Pre-Operating Expenses						248,975	497,951	746,926	995,902	1,244,877	1,244,877	1,244,877	1,244,877
<b>Total</b>						<b>2,427,308</b>	<b>4,854,616</b>	<b>7,281,924</b>	<b>9,709,232</b>	<b>12,138,932</b>	<b>14,319,657</b>	<b>16,500,382</b>	<b>18,681,107</b>
<b>Net Fixed Assets</b>													
Land						558,363	558,363	558,363	558,363	558,363	558,363	558,363	558,363
Buildings						5,794,349	5,552,917	5,311,486	5,070,055	4,828,624	4,587,193	4,345,761	4,104,330
Plant and equipment						13,197,109	11,311,808	9,426,506	7,541,205	5,655,904	3,770,603	1,885,301	-
Office equipment						90,300	77,400	64,500	51,600	38,700	25,800	12,900	-
Furniture and fittings						90,300	77,400	64,500	51,600	38,700	25,800	12,900	-
Motor vehicles						77,400	51,600	25,800	112,769	84,577	56,385	28,192	-
Pre-Operating Expenses						995,902	746,926	497,951	248,975	-	-	-	-
<b>Total</b>						<b>20,803,722</b>	<b>18,376,415</b>	<b>15,949,107</b>	<b>13,634,568</b>	<b>11,204,868</b>	<b>9,024,143</b>	<b>6,843,418</b>	<b>4,662,693</b>
<b>Re-investments</b>													
Motor vehicles									112,769				
<b>Total</b>									<b>112,769</b>				



									Annex 4.2
(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	11,678,547	11,678,547	212,453	34,062	178,391	11,500,156		
	26	11,500,156	11,500,156	212,453	33,542	178,911	11,321,245		
	27	11,321,245	11,321,245	212,453	33,020	179,433	11,141,812		
	28	11,141,812	11,141,812	212,453	32,497	179,956	10,961,856		
	29	10,961,856	10,961,856	212,453	31,972	180,481	10,781,375		
	30	10,781,375	10,781,375	212,453	31,446	181,007	10,600,368		
	31	10,600,368	10,600,368	212,453	30,918	181,535	10,418,832		
	32	10,418,832	10,418,832	212,453	30,388	182,065	10,236,767		
	33	10,236,767	10,236,767	212,453	29,857	182,596	10,054,171		
	34	10,054,171	10,054,171	212,453	29,325	183,128	9,871,043		
	35	9,871,043	9,871,043	212,453	28,791	183,663	9,687,380		
	36	9,687,380	9,687,380	212,453	28,255	184,198	9,503,182	374,073	2,175,365
4	37	9,503,182	9,503,182	212,453	27,718	184,736	9,318,447		
	38	9,318,447	9,318,447	212,453	27,179	185,274	9,133,172		
	39	9,133,172	9,133,172	212,453	26,638	185,815	8,947,357		
	40	8,947,357	8,947,357	212,453	26,096	186,357	8,761,001		
	41	8,761,001	8,761,001	212,453	25,553	186,900	8,574,101		
	42	8,574,101	8,574,101	212,453	25,008	187,445	8,386,655		
	43	8,386,655	8,386,655	212,453	24,461	187,992	8,198,663		
	44	8,198,663	8,198,663	212,453	23,913	188,540	8,010,123		
	45	8,010,123	8,010,123	212,453	23,363	189,090	7,821,032		
	46	7,821,032	7,821,032	212,453	22,811	189,642	7,631,391		
	47	7,631,391	7,631,391	212,453	22,258	190,195	7,441,196		
	48	7,441,196	7,441,196	212,453	21,703	190,750	7,250,446	296,702	2,252,736

									Annex 4.3
(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	7,250,446	7,250,446	212,453	21,147	191,306	7,059,140		
	50	7,059,140	7,059,140	212,453	20,589	191,864	6,867,276		
	51	6,867,276	6,867,276	212,453	20,030	192,424	6,674,852		
	52	6,674,852	6,674,852	212,453	19,468	192,985	6,481,868		
	53	6,481,868	6,481,868	212,453	18,905	193,548	6,288,320		
	54	6,288,320	6,288,320	212,453	18,341	194,112	6,094,208		
	55	6,094,208	6,094,208	212,453	17,775	194,678	5,899,529		
	56	5,899,529	5,899,529	212,453	17,207	195,246	5,704,283		
	57	5,704,283	5,704,283	212,453	16,637	195,816	5,508,468		
	58	5,508,468	5,508,468	212,453	16,066	196,387	5,312,081		
	59	5,312,081	5,312,081	212,453	15,494	196,960	5,115,121		
	60	5,115,121	5,115,121	212,453	14,919	197,534	4,917,587	216,579	2,332,859
	61	4,917,587	4,917,587	212,453	14,343	198,110	4,719,477		
	62	4,719,477	4,719,477	212,453	13,765	198,688	4,520,789		
	63	4,520,789	4,520,789	212,453	13,186	199,268	4,321,521		
	64	4,321,521	4,321,521	212,453	12,604	199,849	4,121,673		
	65	4,121,673	4,121,673	212,453	12,022	200,432	3,921,241		
	66	3,921,241	3,921,241	212,453	11,437	201,016	3,720,225		
	67	3,720,225	3,720,225	212,453	10,851	201,602	3,518,622		
	68	3,518,622	3,518,622	212,453	10,263	202,191	3,316,432		
	69	3,316,432	3,316,432	212,453	9,673	202,780	3,113,652		
	70	3,113,652	3,113,652	212,453	9,081	203,372	2,910,280		
	71	2,910,280	2,910,280	212,453	8,488	203,965	2,706,315		
	72	2,706,315	2,706,315	212,453	7,893	204,560	2,501,755	133,606	2,415,832
7	73	2,501,755	2,501,755	212,453	7,297	205,156	2,296,599		
	74	2,296,599	2,296,599	212,453	6,698	205,755	2,090,844		
	75	2,090,844	2,090,844	212,453	6,098	206,355	1,884,489		
	76	1,884,489	1,884,489	212,453	5,496	206,957	1,677,533		
	77	1,677,533	1,677,533	212,453	4,893	207,560	1,469,972		
	78	1,469,972	1,469,972	212,453	4,287	208,166	1,261,807		
	79	1,261,807	1,261,807	212,453	3,680	208,773	1,053,034		
	80	1,053,034	1,053,034	212,453	3,071	209,382	843,652		
	81	843,652	843,652	212,453	2,461	209,992	633,660		
	82	633,660	633,660	212,453	1,848	210,605	423,055		
	83	423,055	423,055	212,453	1,234	211,219	211,835		
	84	211,835	211,835	212,453	618	211,835	(0)	47,682	2,501,755

Nyambari Nyangwine Resources Tanzania Ltd											Appendix 1	
Clay/Kaoline Bricks Manufacturing Project-Kisarawe District												
Projected Profit and Loss Accounts for years											USD	
Year					1	2	3	4	5	6	7	8
				Reference								
<b>Revenues</b>				Annex 2	<b>33,600,000</b>	<b>38,068,800</b>	<b>43,131,950</b>	<b>44,425,909</b>	<b>45,758,686</b>	<b>47,131,447</b>	<b>48,545,390</b>	<b>50,001,752</b>
Less: Direct operating costs				Annex 3 (a)	12,153,645	13,770,080	15,601,500	16,069,546	16,551,632	17,048,181	17,559,626	18,086,415
<b>Gross Profit</b>					<b>21,446,355</b>	<b>24,298,720</b>	<b>27,530,450</b>	<b>28,356,363</b>	<b>29,207,054</b>	<b>30,083,266</b>	<b>30,985,764</b>	<b>31,915,337</b>
Less: Indirect Operating expenses				Annex 3 (a)	7,644,000	8,660,652	9,812,519	10,106,894	10,410,101	10,722,404	11,044,076	11,375,399
<b>Earnings before depreciation (EBITDA)</b>					<b>13,802,355</b>	<b>15,638,068</b>	<b>17,717,931</b>	<b>18,249,469</b>	<b>18,796,953</b>	<b>19,360,862</b>	<b>19,941,688</b>	<b>20,539,938</b>
Less: Depreciation				Annex 3 (b)	2,427,308	2,427,308	2,427,308	2,427,308	2,429,700	2,180,725	2,180,725	2,180,725
<b>Earnings before loan interest and tax (EBIT)</b>					<b>11,375,047</b>	<b>13,210,760</b>	<b>15,290,623</b>	<b>15,822,161</b>	<b>16,367,253</b>	<b>17,180,137</b>	<b>17,760,963</b>	<b>18,359,213</b>
Less: Loan interest				Annex 4 (a..c)	520,934	448,787	374,073	296,702	216,579	133,606	47,682	
<b>Operating profit/(loss) before tax (EBT)</b>					<b>10,854,113</b>	<b>12,761,974</b>	<b>14,916,550</b>	<b>15,525,459</b>	<b>16,150,674</b>	<b>17,046,531</b>	<b>17,713,280</b>	<b>18,359,213</b>
Less: Corporation tax @			30%		3,256,234	3,828,592	4,474,965	4,657,638	4,845,202	5,113,959	5,313,984	5,507,764
<b>Profit/(loss) after tax (EAT)</b>					<b>7,597,879</b>	<b>8,933,382</b>	<b>10,441,585</b>	<b>10,867,822</b>	<b>11,305,472</b>	<b>11,932,572</b>	<b>12,399,296</b>	<b>12,851,449</b>
Add: Profit/(Loss) b/fwd					-	7,597,879	16,531,260	26,972,846	37,840,667	49,146,139	61,078,711	73,478,007
<b>Profit/(loss) c/fwd</b>					<b>7,597,879</b>	<b>16,531,260</b>	<b>26,972,846</b>	<b>37,840,667</b>	<b>49,146,139</b>	<b>61,078,711</b>	<b>73,478,007</b>	<b>86,329,456</b>

Nyambari Nyangwine Resources Tanzania Ltd										Appendix 2
Clay/Kaoline Bricks Manufacturing Project-Kisarawe District										
Projected Cash flows for 8 years										USD
Year			1	2	3	4	5	6	7	8
		Reference								
<b>Cash inflows</b>										
<b>Capital</b>										
Equity		Annex 1 (c)	8,233,128							
Loan		Annex 1 (c)	15,807,702							
<b>Sub total</b>			24,040,829							
<b>Revenue</b>										
Profit before tax		Appendix 1	10,854,113	12,761,974	14,916,550	15,525,459	16,150,674	17,046,531	17,713,280	18,359,213
Depreciation		Annex 3 (b)	2,427,308	2,427,308	2,427,308	2,427,308	2,429,700	2,180,725	2,180,725	2,180,725
<b>Sub total</b>			13,281,421	15,189,281	17,343,858	17,952,767	18,580,374	19,227,256	19,894,005	20,539,938
<b>Total Cash inflows</b>			<b>37,322,250</b>	<b>15,189,281</b>	<b>17,343,858</b>	<b>17,952,767</b>	<b>18,580,374</b>	<b>19,227,256</b>	<b>19,894,005</b>	<b>20,539,938</b>
<b>Cash outflows</b>										
<b>Capital</b>										
Investments		Annex 1 (c)	23,231,030							
Re-investments			-	-	-	112,769	-	-	-	-
Loan repayments		Annex 4 (a..c)	2,028,503	2,100,651	2,175,365	2,252,736	2,332,859	2,415,832	2,501,755	-
<b>Sub total</b>			25,259,534	2,100,651	2,175,365	2,365,505	2,332,859	2,415,832	2,501,755	-
<b>Revenue</b>										
Change in working capital		Annex 3 (a)	809,799	107,703	122,028	31,186	32,121	33,085	34,078	35,100
Corporation tax		Appendix 1	3,256,234	3,828,592	4,474,965	4,657,638	4,845,202	5,113,959	5,313,984	5,507,764
<b>Sub total</b>			4,066,033	3,936,295	4,596,993	4,688,824	4,877,324	5,147,044	5,348,062	5,542,864
<b>Total Cash outflows</b>			<b>29,325,567</b>	<b>6,036,947</b>	<b>6,772,358</b>	<b>7,054,329</b>	<b>7,210,183</b>	<b>7,562,876</b>	<b>7,849,817</b>	<b>5,542,864</b>
<b>Net cash flows</b>			<b>7,996,683</b>	<b>9,152,335</b>	<b>10,571,500</b>	<b>10,898,438</b>	<b>11,370,192</b>	<b>11,664,380</b>	<b>12,044,188</b>	<b>14,997,074</b>
Add: Beg Cash balance			-	7,996,683	17,149,018	27,720,519	38,618,957	49,989,149	61,653,528	73,697,716
<b>Closing cash balance</b>			<b>7,996,683</b>	<b>17,149,018</b>	<b>27,720,519</b>	<b>38,618,957</b>	<b>49,989,149</b>	<b>61,653,528</b>	<b>73,697,716</b>	<b>88,694,791</b>



Nyambari Nyangwine Resources Tanzania Ltd											Appendix 4		
Clay/Kaoline Bricks Manufacturing Project-Kisarawe District													
Discounted Cash Flows - Internal Rate Return											USD		
Year					0	1	2	3	4	5	6	7	8
				Reference									
<b>Cash inflows</b>													
Profit before interest and tax			Appendix 1	-	11,375,047	13,210,760	15,290,623	15,822,161	16,367,253	17,180,137	17,760,963	18,359,213	
Depreciation			Annex 3 (b)	-	2,427,308	2,427,308	2,427,308	2,427,308	2,429,700	2,180,725	2,180,725	2,180,725	
Residual value of fixed assets			Annex 3 (b)	-	-	-	-	-	-	-	-	4,662,693	
Recoupment of working capital			Annex 3 (a)	-	-	-	-	-	-	-	-	1,205,100	
<b>Total cash inflows</b>				-	<b>13,802,355</b>	<b>15,638,068</b>	<b>17,717,931</b>	<b>18,249,469</b>	<b>18,796,953</b>	<b>19,360,862</b>	<b>19,941,688</b>	<b>26,407,732</b>	
<b>Cash outflows</b>													
Investments			Annex 1 (c)	23,231,030	-	-	-	-	-	-	-	-	
Reinvestments			Annex 3 (g)		-	-	-	112,769	-	-	-	-	
Corporation tax			Appendix 1	-	3,256,234	3,828,592	4,474,965	4,657,638	4,845,202	5,113,959	5,313,984	5,507,764	
Change in working capital			Annex 3 (f)	-	809,799	107,703	122,028	31,186	32,121	33,085	34,078	35,100	
<b>Total cash outflows</b>				<b>23,231,030</b>	<b>4,066,033</b>	<b>3,936,295</b>	<b>4,596,993</b>	<b>4,801,593</b>	<b>4,877,324</b>	<b>5,147,044</b>	<b>5,348,062</b>	<b>5,542,864</b>	
<b>Net cashflows</b>				<b>(23,231,030)</b>	<b>9,736,322</b>	<b>11,701,773</b>	<b>13,120,938</b>	<b>13,447,876</b>	<b>13,919,629</b>	<b>14,213,817</b>	<b>14,593,626</b>	<b>20,864,868</b>	
<b>IRR</b>					<b>49.46%</b>								

**Clay/Kaoline Bricks Manufacturing Project-Kisarawe District**

**Sensitivity analysis of the Project's Profitability**

<b>Factors considered</b>		<b>IRR</b>
<b>Base case</b>		49.46%
1. Reduction of selling prices by	10.00%	40.47%
2. Increase in operating costs by	10.00%	42.64%
3. Reduction of production capacity utilisation by	10.00%	44.79%
4. Reduction in CAGR's capacity utilization CAGR by	10.00%	48.96%



## Clay/Kaoline Bricks Manufacturing Project-Kisarawe District

Payback Period

USD

Initial Investment Capital Cost

23,231,030

YEAR	PROFIT AFTER TAX	DEPRECIATION	TOTAL	CUMULATIVE
1	7,597,879	2,427,308	10,025,187	10,025,187
2	8,933,382	2,427,308	11,360,689	21,385,876
3	10,441,585	2,427,308	12,868,893	34,254,769
4	10,867,822	2,427,308	13,295,130	47,549,899
5	16,150,674	2,427,308	18,577,982	66,127,881
6	11,932,572	2,180,725	14,113,296	80,241,177
7	12,399,296	2,180,725	14,580,021	94,821,199
8	12,851,449	2,180,725	15,032,174	109,853,373
Cumulative benefit at end of year 2				<u>21,385,876</u>
Difference to be recouped in year 3				1,845,154
<b>So the payback period of the project is 2 years and 3 months</b>			<b>1.72</b>	<b>3</b>

