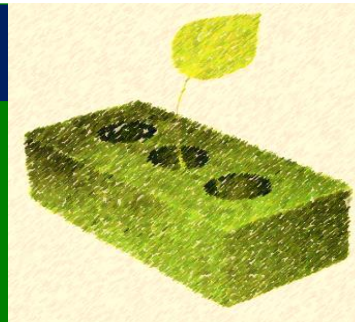


## Green Brick Technology Transfer to Malawi: Market Assessment Report for setting up Vertical Shaft Brick Kilns (VSBKs)\*



### SUMMARY

In Malawi, increasing demand for housing has put tremendous pressure on the building material sector, resulting in deforestation, rising costs and poor quality construction.

In Malawi, more fuel wood is consumed than re-grown, leading the country towards massive deforestation. Burnt Clay bricks are the only bricks used in Malawi where wood is used as the source of fuel. To make enough bricks for a small family house, wood from three large mango trees or the equivalent would be required. Current brick making processes thus use considerable amounts of forest wood and are of poor quality (Picture 1). In the clamp around 20MT wood is consumed to fire 40,000 bricks. Estimates indicate that 1.7 billion units of burnt clay bricks will be annually required for walling alone, produced at the cost of a whopping 850,000 tonnes of wood.

At this rate, Malawi is staring at complete deforestation within 25-30 years.



**Picture 1:** A brick kiln, which is burnt for 24 hours

The Government of Malawi is interested in solutions and the VSBK brick technology promoted by TARA appears a viable option (Picture 2). A market assessment of VSBK conducted by TARA informs on the viability of developing entrepreneurship, the challenges to be overcome and the support required. The financials are given in Table 1.

**Picture 2:** VSBK bricks



*The assessment indicates the requirement of at least 1,000 VSBKs to meet urban demand alone. The capital investment required is between MWK 8.5-15 million, depending on number of shafts, with a payback period of 2-3 years (see Table 1).*

***An enabling policy and financial environment, coupled with the development of local capacities will accelerate the transfer and uptake of this resource saving and employment generating technology.***

**Table 1: VSBK financials**

Parameter	VSBK - one shaft	VSBK- Two shafts
Daily output (bricks)	4,500	9,000
Days of operation	300	300
Annual capacity (bricks)	1,350,000	2,700,000
Capacity utilisation	90 %	90 %
Annual production (bricks)	1,215,000	2,430,000
Investment (In MWK)	8 million	15 million
Selling price (in MWK)	15 /brick	15 /brick
Rate of return	<b>Around 3 years</b>	<b>Around 2 years</b>

**Exchange rate: 1 USD = 250 MWK**

\* This market assessment report draws its analysis from a Knowledge Partnership Programme-funded project 'South-south technology transfer: Low carbon building technologies' being implemented by Technology and Action for Rural Advancement (TARA), with technical support from (DA) Development Alternatives. The project is supported by DFID, UK.

## THE HOUSING CHALLENGE

Malawi is a land-locked country in Southern Africa (Figure 3), with a population of around 15 million. The urbanisation rate of 5.22 per cent has put tremendous pressure on the building materials sector. The constraints in supply of material has resulted in poor quality construction and increasing costs.



Figure 3: Map of Malawi

Estimates indicate an annual construction requirement of 21,000 dwellings to meet urban housing needs alone. This will require 1.7 billion units of burnt clay bricks annually only to meet walling requirements. Coupled with rural housing demand, the figures will rise dramatically.



Figure 4: Brick kiln using Wood logs

Wood is the prime source of energy for brick industry (Fig 4). The current brick production requires around **850,000 metric tonnes of wood** each year, resulting in massive deforestation.

At this rate of fuel wood consumption, the entire country will be deforested within 25-30 years only from the brick industry (Figure 5).

The constraints in supply the rising demand has resulted in a decline in construction quality and rising costs. This has prompted the Government of Malawi to explore alternatives: The Department of Energy Affairs, Department of Environment



Figure 5: Wood logs for brick Industry

Affairs and National Construction Industry Council have expressed a keen interest in promotion of Eco-friendly building materials like bricks and tiles from India.

## VSBK TECHNOLOGY: A VIABLE OPTION

Vertical Shaft Brick Kiln technology (EcoKiln) is an energy efficient technology covering the entire brick production system (Figure 6). Greenhouse gas emissions are less, making it an obvious choice for the carbon market. Being versatile, VSBK can be adapted to any scale of production. It produces consistent quality bricks with higher returns than clamp brick production.

The basic criteria used to select the technology are based on production capacity, fuel type, product quality, investment capacity and ability to tap the carbon market. Use of carbonaceous waste materials in green bricks is an integral part of the technology. Benchmark operation of EcoKiln can save more than 40 per cent energy consumed with reduction in environmental emission by more than 80 per cent as compared to traditional firing technologies available in India and most Asian countries.



Figure 6: VSBK Kiln Technology

*Adoption of VSBK Technology would result in savings of 850,000 -1,000,000 tonnes of wood per year in Malawi.*

Advantages of VSBK Technology include lower fuel consumption and lower SPM (suspended particulate matter) emissions. The kiln can be operated throughout the year as the roof protects it from the vagaries of weather.

Malawi has one of the most suitable quality of coal required to be used in VSBK system. With a calorific value between 26 - 29 MJ/kg it is of appropriate quality. Adequate quantity is also available in the Northern part of Malawi with explorable deposits in the Southern part. Although coal is not the ideal clean energy, this still is a stepping stone towards reducing forest deforestation.

The VSBK technology was developed in China and adapted by Development Alternatives (DA) and TARA. In India, DA has facilitated the setting up of more than 150 VSBKs with entrepreneurs in Madhya Pradesh, Bihar, Odisha, Jharkhand, Rajasthan, West Bengal, Maharashtra, Uttar Pradesh and Chhattisgarh. It consists of one or more shafts located inside a rectangular brick structure. The shafts are 1 to 1.25 meters wide with nominal lengths of 1 m, 1.5m, 1.75m or 2.0 m. The inside surface is a brick wall, often lined with refractory fireclay bricks. The gap between the shaft wall and outer kiln wall is filled with insulating materials such as clay and rice husk. Provision for peep-holes and thermocouple probes are provided along the shaft height to monitor the position of fire as well as temperature profile of the kiln.

The shaft is loaded from the top in batches of green bricks. Each batch typically contains four layers of bricks set in a predetermined pattern. The stack of bricks rest on square support bars (which can be removed or inserted) and supported in turn by a pair of horizontal beams across the arches in the unloading tunnel. For evacuation of exhaust gases, typically, two rectangular chimneys are provided at opposite corners of each shaft. Lids are provided to cover the shaft top, which direct the gases to the chimney through the flue system.

#### **VSBK economic and entrepreneurship highlights**

- VSBK is expected to have its own niche market, thereby promoting the growth of small and medium enterprises (SME) sector in Malawi.
- More than 1,000 VSBKs single shafts are required to meet urban demand
- VSBK technology is suitable for small to medium scales of brick manufacturing. It matches the capacity expectations of most entrepreneurs and is modular.

## **Potential Impacts**

### **Environmental Impacts**

- Saving of 850,000 tonnes of fuel wood annually
- Saving of 1,500,000 tonnes of CO<sub>2</sub> annually
- Reducing the embodied energy in housing, thereby pioneering the path of energy saving in Africa

### **Economic Impacts**

- Recurring income of USD 9 million worth of foreign exchange annually
- Creation of more than 1,000 small to medium scale enterprises in the SME sector and ancillary industries

### **Social Impacts**

- Creation of more than 20,000 sustainable **Green Jobs**, thereby helping in reducing poverty
- Provision of healthy working conditions for kiln workers due to reduced exposure to smoke and exhaust gases
- Yearlong production that ensures stable, steady and enhanced source of income for entrepreneurs and workers
- Improving the quality of housing and incurring a saving of around 40 per cent from bricks and mortar alone.

- The capital investment is in the range of 8.5-15.5 million MWK (depending on the number of shafts) and is higher compared to clamp (where no capital expenditure is required) kilns. The payback period is around 2-3 years (considering 1 year as stabilisation and training period).
- Even though the price of the VSBK bricks at 15 MWK is higher than the 5 MWK clamp bricks

available, market intelligence suggests a consumer willingness to pay due to the better quality standardised bricks on offer.

- If there are constraints in capital investment or uncertainty in the market, an entrepreneur can start with a single-shaft VSBK and add shafts as his business grows. The flexibility of the VSBK can meet any production capacity.

## DRIVERS AND BARRIERS

Market and finance	Capacities	Policy
<ul style="list-style-type: none"> <li>•Market and finance</li> <li>•Formal market is small and cannot meet the growing demands</li> <li>•Informal market has cost advantage but suffers from poor quality</li> <li>•Consumer willingness to pay</li> <li>•Increased interest in investment by private sector</li> <li>•Lack of support systems</li> <li>•Entrepreneurial ecosystem not well developed.</li> </ul>	<ul style="list-style-type: none"> <li>•Low skill levels</li> <li>•Lack of technology solutions</li> <li>•Skill development opportunities through training</li> </ul>	<ul style="list-style-type: none"> <li>•Keen interest from decision makers</li> <li>•Lack of quality assurance and control</li> <li>•There are no government schemes to help build the programme</li> </ul>

## WAY FORWARD

- Policy instruments to incentivise use of VSBK bricks
- Fiscal and regulatory measures to promote usage
- Trained and skilled workforce for promoting the technologies and achieving scale
- Hand holding support to the first set of enterprises
- Support this technology transfer through building local capacities to transfer the skills and know-how to local institutions and individuals.

***India can support this process of technology transfer through building local capacities to transfer the skills and know-how to local institutions and individuals.***

*An entrepreneur has been identified and a VBSK is being set up. Training is provided to the entrepreneurs and their workers.*

*Lessons learnt from the pilot will enable improved planning for subsequent units.*

## SPIN OFFS

- Malawi holds potential for the adoption of other green building materials.
- Mozambique, Kenya, Ethiopia, Zambia and Tanzania have expressed interest in clean construction technology transfer.



## REFERENCE

- Development Alternative, Market Assessment report: South-South Technology Transfer Low Carbon Building Technologies (<http://www.ipekpp.com> )

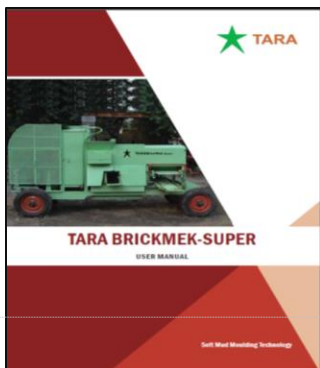
## AVAILABLE MANUALS TO SUPPORT UPTAKE OF VSBK TECHNOLOGY TRANSFER:



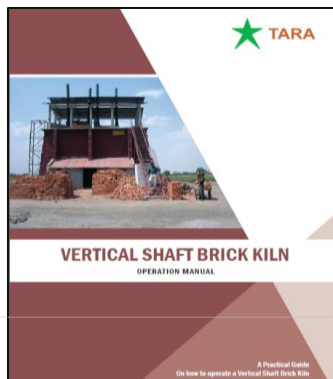
DESIGN MANUAL



CONSTRUCTION MANUAL



USER MANUAL



OPERATIONAL MANUAL

These manuals can be accessed from KPP Website - <http://www.ipekpp.com/>

*KPP is a South-South cooperation programme promoting knowledge sharing in the areas of Food Security, Resource Scarcity and Climate Change; Health and Disease Control; Trade and Investment; and Women and Girls. KPP is funded by the Government of UK's Department for International Development (DFID) and managed by a consortium led by IPE Global Private Limited under its Knowledge Initiative. The main objective of KPP is 'Gathering and uptake of evidence on issues central to India's national development that have potential for replication in LICs and impact on global poverty'.*

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