

Final report

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THE POTENTIAL FOR BENEFICIATION OF INDUSTRIAL MINERALS IN RWANDA

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I. Background

Beneficiation of local mineral resources is a major policy objective for Rwanda as it pursues higher income status. A local mineral processing industry would raise the value of exports, generating higher incomes for the industry and also raise mining contribution to GDP. However, a semi-skilled workforce, limited access to infrastructure, and insufficient capital investment continues to impede modernization of mining operations. Several interventions to address these constraints have been implemented, but these investments tend to have medium to long-term maturity.

This report argues that the viability of a domestic mineral processing industry need not depend entirely on the existence of metallic mineral industries. Unlike most of the metal commodities, the whole value chain of industrial minerals can be operationalized in low-income, low-technology countries like Rwanda. Rwanda has mapped sufficient deposits of industrial mineral resources comprising of sand, clay, dimension stone and semi-precious stones. Although of limited worth when unprocessed, their value substantially rises with processing. For instance, sand is the main raw material for glass. Clay and dimension stones can be processed into high-value construction materials. Semi-precious stones can be cut and polished into valuable jewellery and ornaments. A market for these products exists locally and regionally, and is projected to increase as rapid urbanisation stimulates demand for quality building materials.

With ubiquitous raw materials in the region, Rwanda can develop a comparative advantage in industrial minerals processing, and attract superior raw materials from the region, supplementing local resources. Such an industry would enjoy the natural protection accorded by its geographical location, and neighbouring countries' loss of competitiveness which comes from their mineral dependency. For instance, oil (Uganda, Kenya), gold (Tanzania, Kenya) and diamonds (Kenya) tend to attract productive resources into prospecting and production, raising costs of production in other sectors. In addition, logistics costs prevent international competitors from entering the local market.

In addition, industrial minerals processing is relatively labour intensive and less dependent on electricity, advanced skills and technology. With a ready and secure market, and with relatively less investment, a competitive industrial minerals sector satisfying local and regional markets can generate comparable economic diversification and structural transformation as a metals industry. Moreover, a productive industrial minerals sector would also stimulate complimentary goods and services supply industries which can in turn promote the viability of metal processing industries.

A careful evaluation of demand and corresponding supply capacity requirements would guide strategic interventions to develop a competitive industrial minerals sector within a short time-frame. For instance, it would enable selecting optimal institutional arrangements, and identifying skill and capacity gaps. A well implemented policy would then give Rwanda an early movers advantage to capture the market opportunities deriving from the trend towards inter-African trade liberalisation. The rest of this report is organised as follows; section 2 gives an overview of Rwanda's minerals sector including resources and recent performance. Section 3 describes the mineral resources of Rwanda's neighbouring countries as potential sources of raw materials. Sections 4-6 describe Rwanda's

industrial minerals resources, the potential for local processing and critical policy outcomes towards achieving this goal.

II. Current situation overview

A good starting point for a discussion of the potential of the industrial minerals sector and its strategies would be to look at the current situation in the industrial sub-sector.

III. Regional minerals industry overview

East Africa is richly endowed with a variety of mineral resources, although their viable potential is yet to be fully established. Mineral industries in the region are fairly infant, accounting for a negligible share of GDP. Commodities are exploited in raw form and the workforce is dominated by semi-skilled artisanal labour.

Kenya

Kenya's mining industry is dominated by the production of non-metallic minerals. These occur in four belts of minerals - the gold green stone belt in western Kenya, which extends to Tanzania; the Mozambique belt passing through central Kenya, the source of Kenya's unique gemstones; the Rift belt, which has a variety of resources including soda ash, fluorspar and diatomite; and the coastal belt, which has titanium.

Tanzania

Tanzania's mineral industry primarily focuses on Gold, and is Africa's fourth largest producer after South Africa, Ghana and Mali. Other commodities include diamonds, gold, base metals, gemstones (including the unique Tanzanite) and a variety of industrial minerals (such as phosphates, mica, gypsum, limestone, graphite, quartz and vermiculite) that have a wide range of applications in ceramics, pottery, brick and tile-making, and glass manufacture as well as nickel, cobalt, copper, apatite, niobium, iron ore and coal.

Uganda

Uganda is well endowed with one of Africa's most diverse mineral commodity offerings. The country's list of minerals resources includes; Copper, Cobalt, Tin, Phosphates, Vermiculite, Diamond, Gold, Petroleum, Chronite, Magnetite, Uranium, Iron ore, clays, feldspar, diatomite, silica sand, glass, sand gravel, and construction materials such as granites and gneisses. Gold is Uganda's premier mineral export, although commercial production of crude oil is scheduled to begin in 2020.

IV. Overview of Rwanda's mineral assets

The key mineral ores currently being mined and traded in Rwanda are cassiterite, wolframite, colombo-tantalite and gold (Au). Anomalies of other key minerals like nickel, chromium, cobalt, lead, zinc, uranium, thorium, copper and lithium also exist, and some are currently being explored. Historical records also indicate the presence of semi-precious stones (tourmaline, topaz, corundum, chiastorite, amethyst, sapphires, opal, agate and flint) and industrial minerals and rocks which can be cut and polished for high value construction materials, jewellery monumental objects. Although measured estimates of Rwanda's mineral reserves do not exist, some location specific feasibility, and a long history of mining suggests a high potential for Rwanda's mining industry.

Status of Rwanda's mineral industry

Since 2005 Rwanda has implemented progressive reforms to its legal, regulatory and institutional framework to encourage private sector-led mineral production and trading. The government has invested in capacity building and public goods including infrastructure and geo-data. This has attracted foreign investors into exploration and production of mineral and quarry products. In turn employment in mining has increased together with exports and tax revenues to a limited extent. In 2017, employment in mining was 38,000 while exports reached \$373 million--more than double the value in 2016. The tax base has been progressively widened and currently includes mineral royalties in addition to corporate income tax and personal income tax. This growth driven by mineral prices has masked the structural inefficiencies of the country's production model: one reliant principally on small production sites, high manual labor and rudimentary technology. What is required is a veritable shift in mining techniques on existing sites, alongside commodity diversification to secure a stable reliance on export earnings.

Rwanda's mineral industry constraints

The strategic imperative for a modernised productive mining sector is embodied in frequent legal and regulatory reforms, restructuring of institutions, state-led exploration activities and investment in capacity building. However, several binding constraints prevent the sector from achieving its potential. For instance, recent sectoral performance has been driven by proliferation of Artisanal and Small-scale Mining (ASM). This has been dictated in large part by the type of deposits; relatively scattered low grade vein (pegmatite/quartz) deposits, a phenomenon which has prevented the scalability of mining projects in Rwanda. A tailored profitable business model for Rwanda's particular resource endowment is still a point of discussion. However, there are typical challenges that should be addressed even as the optimum business models continue to be discussed. These include;

- Limited to non-availability of funding for improving productivity by ASM miners due in part to; (i) the perceived high risk in mining, (ii) poorly prepared bankable projects and lack of collateral; however, it is important to remember that not all financial institutions, even in other areas, are quick to fund mining businesses, especially the exploration stages;
- Low professional capacity of ASM miners which hampers their ability to develop and manage their businesses professionally resulting in the inability to quickly evolve efficient professional mining and minerals processing;
- Production at some sites reaching limiting depths of 'easy to mine' resources using traditional methods. Traditional methods of mining need to be upgraded;
- By 2017 the number of registered mining companies exceeded 500--mainly ASMs--hence the need to develop models of partnerships to upgrade and upscale projects in order to afford crucial services required for a modern mining sector.
- Mineral commodities are exported as ore concentrates of relatively low value compared to their end products. There are no industrial processes that would transform raw materials into high value intermediate and/or final products. As such export revenues are vulnerable to world prices which fluctuate within small cycles of time which destabilize the largely small scale operators;

- Insufficient skilled labour such as mining engineers, geologists, and supporting professionals like mineral economists and mining agreements lawyers. This hinders the capacity to modernize mining operations and enforce sectoral regulations.
- Existing geologic and mineral data is not made digitally available in the right formats, limiting access by would be key investors;
- The Dodd Frank Act which operates as a de-facto embargo on mineral exports from the DRC and adjoining countries as the requisite traceability systems raises the costs of production for sector operators.

V. Potential for beneficiation of industrial mineral resources

As the Rwandan government vigorously pursues value addition domestically, one can understand why processing of its main export commodities (tin, tungsten tantalum) is the main preoccupation at the moment. This achievement would hedge against price risk and stabilize export revenues, and contribute to Rwanda's GDP.

However, if we consider the binding human capital and infrastructure constraints, the mid-level concentration within global base metal supply chains marked with high barriers to entry, it can be argued that domestic beneficiation of metallic mineral resources remains a distant objective for Rwanda and its neighbouring countries. Moreover, a volatile geopolitical environment which has in the past excluded the DRC and its adjoining countries from lucrative markets in Europe and the US is perceived by potential investors to be a significant deterrent to FDI into mining.

Industrial mineral resources including sand, rocks and semi-precious stones which are thought to be of limited benefit, substantially gain in value once transformed into finished products. Unlike the advanced industrial processes characteristic of metallic commodities, industrial mineral resources require less technological and financial input, yet they may generate the same transformational benefits in the short-run, while developing local mineral supply chains in preparation for future metallic processing. The following sections considers the potential for developing domestic dimension stones, glass and ceramic industries.

Potential for Dimension stone fabrication

Dimension stones are used for construction in their natural form as floor tiles, facing (veneer), monuments; etc. The most common dimension stones are cut from granite, marble/limestone/dolomite, slate, sand stone/quartzitic sand stone, basalt etc. These are preferred for their colour, texture, pattern and durability and absence of defects. Value chain activities in this industry include exploration, production, cutting and polishing, marketing and use in construction.

Regional and global industry

In 2016 global trade in dimension stones reached \$738 million dominated by India, China, Brazil, Italy, and Spain. Fastest growing markets are in South Asia (Hong Kong, Vietnam, Bangladesh) and continental Europe (United Kingdom, Italy, Switzerland). It is estimated that only one third of global production is exported, and this is due in large part due to its bulky nature. Within the East African Community dimension stones are entirely non-tradable.

Local industry

Dimension stones are ubiquitous to Rwanda's geology, especially granite, slate and sandstone. A granite processing factory was established in 2016 with an annual production capacity of 2000 MT—

the only one of its kind in East Africa. In 2017 it produced cut granite tiles of around \$1 million, satisfying roughly 40 percent of the local market. It is worth noting that several major new buildings (e.g. The Marriott Hotel, The Convention centre etc.) are tiled and faced with products from this industry. This is indicative of the potential of the local dimension stones industry to compete with imported tiles, and supply the growing local and regional demand generated by rapid urbanisation.

Potential for glass manufacturing

Glass is a (usually) transparent, non-crystalline amorphous solid that has many important applications worldwide in a variety of industries. The most common uses for glass are in windows and bottles, although more recently demand for solar Photo Voltaic (PV) glass is increasing rapidly. The major components of glass are sandstone, soda ash and silica.

Global and regional glass industry

Global construction glass demand stands at \$111 billion while the solar glass market is valued at \$24 billion. Over 90 percent of global glass supply and demand is accounted for by China Europe, North America and Asia Pacific countries. Within the East African Community, construction accounts for at least 30 percent of GDP and is among the fastest growing sectors stimulated in large part due to rapid urbanisation.

Local glass industry

Rwanda's glass market is valued at \$3.5 million entirely satisfied by imports. At present a local glass industry does not exist in Rwanda. However, findings from recent feasibility studies and market surveys suggest that there a domestic glass bottle industry would be viable. High quality quarzitic sandstone deposits used in the manufacture of transparent glass have been mapped and are known to exist in abundant supply. Complimentary raw materials such as soda ash and silica which do not occur in Rwanda exist abundantly in neighbouring countries. Demand for glass for construction is projected to increase with urbanisation and by shift to solar electrification.

The potential for ceramic manufacturing

An operational definition of ceramics covers refractory, inorganic and non-metallic material. Ceramic finished goods can be traditional; including pots, cups, tiles and advanced; including; bricks, floor tiles, roofing tiles, kiln linings, temperature resistant crucibles, sanitary ware.

Local ceramics industry

An estimate of the size of the local market for ceramic materials is difficult to obtain, as the industry has historically existed on an informal artisanal scale. A conservative estimate would be that it is substantial as 3 in 5 households are roofed with clay tiles, and 1 in every 5 households are constructed with clay bricks. A local ceramics industry in Rwanda would initially primarily concentrate on the traditional ceramics, and later evolve into more advanced ceramics. The clays of Rwanda can be used for making: bricks and tiles for construction, floor/roof/veneer tiles, glazed bricks and tiles, tableware, ceramics, porcelain (china ware), insulating and electric fittings, refractory and various elements for decoration, pottery, drainage pipes, or for fine ceramics (china) such as: dishes, sanitary, tiles and others. Considering the existence of abundant raw materials, a wide range of products can be manufactured with relatively low investment and technological inputs.

VI. Critical outcomes for a development minerals policy

The rationale for value addition of mineral resources stems from the need to eliminate poverty by stimulating economic diversification and structural transformation of labor agriculture into more productive tertiary activities. This goal is reiterated in several government policies and strategies

including; The National Strategy for Transformation, National Mining Policy, National Export Policy and National Industrial Policy.

Previous government policies have focused on achieving local mineral processing industries. However, developing a competitive industrial minerals sector supplying high-value construction materials for the local and regional market can generate similar transformational benefits for substantially less investment. Moreover, a vibrant industry stimulates the establishment of complimentary services which can act as a catalyst for competitive metallic minerals processing sector. A thorough diagnostic of the industrial minerals industry would guide the targeting of policy towards achieving the following outcomes.

1. **Appropriate governance structures are required to coordinate an ASM-dominated industrial minerals sector.** Legal and institutional reform - including a public institution to cater to the specific needs of ASM operators - would raise state capacity to monitor and enforce regulations. Strategic guidance and sectoral priorities would be obtained from multi-stakeholder forums.
2. **Raise capacity of artisanal workers by adapting training methods to local conditions.** Potential topics can include rock cutting, polishing and design, business training, occupational safety and environmental sustainability. Knowledge can be transferred effectively by setting up regional demonstration centres where viable production techniques can be experimented.
3. **Raise the competitiveness and sustainability of industrial mineral processing.** A successful industrial minerals sector can only be driven by market-mediated incentives. Institutional support in this regard can focus on R&D to raise the quantity and quality of products, and profitability by extension. A local content program to benefit the most competitive suppliers can also be implemented, capitalizing on several high-profile infrastructural projects. Tailored financial instruments to cater for the specific needs of industrial minerals can also be designed.

VII. Conclusion

This report has presented a case for exploiting Rwanda's abundant industrial mineral resources as a transitional objective towards achieving mineral-led industrialisation. Prevailing capabilities dictate that Rwanda's mineral commodities are exported as low-value ore concentrates. Interventions addressing the binding constraints including, aerial surveys, capacity building have rekindled private sector interest in the sector. However, as these investments tend to have medium to long-term maturity, a viable metallic mineral processing industry might be a distant prospect.

In the interim, Rwanda's abundant industrial minerals deposits can be exploited to produce high-value construction materials to satisfy the growing domestic and regional demand. These products would benefit from natural protection accorded by high logistics costs preventing western and Asian competitors from accessing the market, and a loss of competitiveness in neighbouring countries which results from dependency on internationally traded mineral commodities.

A competitive, modernised local industrial minerals industry would generate comparable transformational benefits as metallic processing, albeit with substantially less investment.

To start the strategy of value addition to the above products and indeed to all the other mineral resources, the following steps have to be considered:

- 1) Understanding the potential in relation to existing raw materials and their derivatives;
- 2) Understanding the processes, required inputs and required industrial additives to produce diverse products;

- 3) Beginning to develop targeted policy for preferred value addition ventures and attraction of investments;
- 4) Developing the right infrastructural and human resource;
- 5) Aligning and initiating supporting and benefiting industries and businesses.

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