

8. Small-scale mining and processing of agrominerals

In the foregoing chapters, accounts of various agrominerals and their agronomic importance have been discussed for various biomass production systems. Details of the occurrences of these agrominerals and pertinent agronomic experiments with these resources are provided in the country profiles that follow. The agrominerals discussed are mainly for small-scale and local agricultural use and for potential uses in forestry and horticulture. They are restricted to small-scale, site-specific and adapted use. Some of the agrominerals are available in sub-Saharan Africa but have not been tested for agricultural use, for example zeolites, pumice and the many 'waste' or byproducts from mineral related industries.

There are several large-scale agromineral deposits being mined in sub-Saharan Africa, for example, the phosphate ores in Togo, Senegal and South Africa. Emphasis in this book is on the many small-scale deposits and their potential use in agriculture, forestry, agroforestry and horticulture. One has to be reminded that for every very large deposit, there are many orders of magnitude more similar small- and medium-scale deposits. There are areas that are naturally endowed with minerals due to their geological setting, while others have clearly less potential. It is obvious, however, that there is enormous potential for the increased use of readily available agrominerals to maintain or enhance soil fertility.

To develop these small-scale resources one has to use similar but size-adapted methodologies and techniques. Fortunately there is already a large body of experience with appropriate mining and processing in many countries of sub-Saharan Africa. Most of the appropriate mining and processing techniques are used in other industries, for example the small-scale gold mining industry. But many of the techniques can be easily adapted and modified to suit the small-scale mining and processing of industrial minerals like phosphate rocks.

Appropriate processing techniques and equipment that could be used for agromineral processing include:

- locally available and locally built stamp mills used in the gold fields of Zimbabwe,
- the locally developed tractor driven ball mills in the small scale gold mining camps in northern Tanzania,
- the modified mobile concrete mixer for partial acidulated phosphates made in Zambia (Borsch 1993),
- the simple and robust phosphate blend pelletizer, developed in Zimbabwe and adapted in Uganda.

These are examples of simple and robust technologies 'made in Africa,' which could be used to crush, grind and even process geological resources near their sources. There are several small industries and support institutions in sub-Saharan Africa that provide assistance for appropriate processing technologies to small-scale operators. From another continent with similar constraints, the 'semi-mechanized' approach of small Indian mines seems particularly applicable to many other developing countries that have a large underemployed labor force and limited availability of foreign exchange to buy sophisticated mining equipment. Operating costs for small-scale open cast mining differs from place to place and commodity to commodity but are in the general range of US \$1-10 per tonne. Depending on the size of the operation, on the appropriate equipment used, mineral hardness etc., crushing and grinding cost another US \$4-10 per tonne. For many agrominerals such as scoria and some zeolites, 'mining' may simply involve excavation of the unconsolidated material with a shovel followed by screening and bagging and/or bulk transport.

Small-scale agromineral development is a labor-intensive activity (International Labour Organization 1999) that can significantly reduce not only mining and processing costs, but, by extracting and developing agromineral deposits closer to the farming sites, also reduce unit transportation costs. In addition to enhancing agricultural productivity and sustainability for resource poor farmers, small-scale mining and development of agrominerals will generate livelihood opportunities for many people directly or indirectly involved in these activities. Employment opportunities in rural areas and additional income-generating opportunities can substantially improve the livelihoods of many people and reduce poverty.

Small-scale mining is often seen as an unregulated illegal activity. Especially small-scale gold mining operations are often under-capitalized, under-mechanized, and the operators often lack technical and managerial skills (Noetstaler 1995). Small-scale miners often operate under poor living and working conditions, employ children and avoid taxes. In addition, small-scale mining can be hazardous to human health and detrimental to the environment. Positive sides of small-scale mining include: low investment costs and a short lead time from discovery to production. Small-scale miners often utilize otherwise unexploited small deposits, and they employ low-skill labour. Small-scale mining encourages indigenous entrepreneurship, creates employment and spin-off jobs, and, properly supported, can contribute to poverty alleviation and rural development.

To start small-scale development of the new agromineral sector it will be necessary

- to develop this sector in an orderly manner,
- to develop, together with the stakeholders, the adapted technologies needed for a successful venture,
- to invest with the stakeholders into basic and appropriate mining and processing equipment,
- to train the stakeholders in 'bottom-up centres,'
- to formalize and legalize their activities.

It is important to forge links and form partnerships between farmers, entrepreneurs, communities and government and non-governmental organizations.

In many development agencies the word 'mining' has the connotation of exploitation of natural resources with all the negative images of environmental degradation, social disruption and trans-national involvement and resource transfers. Mining seemingly contradicts the sustainable development paradigm. However, extraction of agrominerals should be viewed differently. These minerals and rocks are utilized for local agricultural needs, for development of infrastructure and for survival. With proper resource management practices, the development of these minerals can increase soil fertility and food production, and will contribute to food security and poverty reduction.

In contrast to small-scale mining of gold and diamonds, which is often illegal and unsupported by local authorities, the extraction of high bulk agrominerals like limestones and phosphate rock will be legal and supported by the community. Unlike precious metals and diamonds, agrominerals are bulky and not easily smuggled across borders.

Agromineral extraction and processing obviously depends on the size, grade, location etc. of the deposits. Large deposits are likely to be developed by larger enterprises, either local, national or international. Small scale agromineral operations can provide wide opportunities for local entrepreneurs (for example operating a crusher/grinder unit), and be run, after an initial setting up of the appropriate technologies, by local craftspersons and local labour. For these operations, the capital requirements are generally low. At some mini-scale agromineral operations, for example, small limestone operations, the mining and processing can be seasonal, run by farmers themselves in the off-season.