

Modeling the ultra-pure quartz exploitation in northeastern madagascar: Impact of the activity on the socio-economical situation of the population

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Abstract

The collection of ultra-pure quartz is a traditional occupation of rural populations in northeastern Madagascar to complement the traditional farming activity, namely the rice crop. In this paper, we model and simulate these phenomena in order to assess the possible impact of this complementary activity on the socio-economic situation of the population. We have used the Multi-Agent System approach. In order to maximize our interpretation of some results and the scope of our analysis, we have implemented our model on two platforms, respectively named Cormas and ADK/RDK. We then examine the simulations and open a socio-economic discussion of the results.

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1. Introduction

1.1. Ultra-pure quartz exploitation

1.1.1. Generalities

Silica (SiO₂), of which quartz represents the most common mineralogical occurrence, constitutes a natural resource long associated with human history. The degree of evolution of the first hominids was, for instance, identified 2.5 millions years ago by the way these hominids manip-

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ulated silica stones (Roche, 1989). Silica was also used in Egypt, 5000 years ago, to make the first synthetic material, glass, and the quartz itself was adopted as an ornamental stone in various proto-civilizations (Egyptian, Greek, Roman, etc.). More recently, in the twentieth century, a particular category of quartz, ultra-pure quartz (i.e. in which the silica level is greater than 99.85%), has been exploited to deal with the evolution of many technological innovations, such as sonar for the detection of submarines, frequency control, time measurement, integrated circuits, optical fibers, etc.). This ultra pure quartz is also now mainly used for the production of high performance glass and artificially cultivated quartz crystals. As such, the ultra-pure quartz is then important for the development of international industries.

1.1.2. Ultra-pure quartz and Madagascar

Since the start of the twentieth century, Madagascar is the second ultra-pure quartz producer in the world behind Brazil (Barthélemy and Orru, 2004). At the beginning, the annual production of both countries was respectively of (around) 15 and 200 tonnes. Throughout that century, they continuously increased their production. By 2000, for an annual world production totaling nearly 2000 tonnes, Madagascar production accounted for a quarter (500 tonnes), while the remaining 1500 tonnes were mainly provided by Brazil.

In Madagascar, the exploitation of quartz, generally undertaken through artisanal mining¹ operation, is necessary since it is considered as a complementary activity within a rural economy, for the most part oriented toward the production of mainly food crops (rice) but also other crops such as vanilla and cloves. An analysis of the quartz network illustrates its societal anchoring and its important role as a non-seasonal activity providing income at a crucial period for the familial economy during the crop breakdown and the plantation period, but also in the case of climate disorders such as cyclones or other phenomena like locust swarm invasions, which sometimes occur in Madagascar. This local necessity involves that the production of ultra-pure quartz will be sure to exist for a long-time yet in Madagascar. And since the population does not actually needs them (it only requires the money counterpart of its extraction), most exploited products will be sent abroad, for international industries uses, as mentioned above, assuring the existence of this necessary product in the world market.

This local exploitation is considered as a first stage of the ultra-pure quartz production in the world. We then start our (long-time) study of the quartz exploitation at this (micro-economical) level.

1.2. Objectives of this work

In fact, although the impact of quartz collection on the local population seems indisputable, a real understanding of this impact is still lacking. Thus, throughout this work, we have attempted to obtain a better understanding of this issue. More precisely, by taking the region of Rantabe in northeastern Madagascar as a case study², we have attempted to model this activity and aimed to assess the possible impact of the value of quartz on the socio-economic evolution of the local population.

This application was developed in order (i) to help in decision making with regard to a strategy of local governance for the reduction of poverty and (ii) to design a system of sustainable

¹ An “artisanal mine” is a generally informal operation exploiting mineral resources by using mostly manual methods and rudimentary tools (a “hunting-gathering” type approach).

² Rantabe was chosen because it still remains one of the main producing regions of quartz in Madagascar.

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