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Economic and Toxicological aspects of copper industry in Katanga, DR Congo

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Abstract

The Katanga province is well known for its copper and cobalt reserves. During the early 2000s a boom of mining projects in Katanga brought again hope for better future to Congolese people. The paper aims to evaluate the impact of recent production recovery on economy and environment. We collected primary and secondary sources on copper industry for economic analysis. We use results of laboratory analysis conducted at the Congolese Office of Control by provincial division of environment for toxicological analysis. The comparison of heavy metal concentration to standards shows that mining industry is the main source of environmental pollution in Katanga. Copper industry generates income for economic growth of the region.

Key Words: copper industry, economy, toxicology.

Introduction

At the early phase of extraction in copper industry, managers are more preoccupied with addressing profit maximization than preserving the environment¹. Environmental pollution is an important issue to integrate into mining projects for economic development of Katanga province in DR Congo. This paper reviews the impact of mineral processing on economy and environment in Katanga province. The question is whether the recent output recovery assures both economic growth and environmental protection in Katanga province? This research aims to explain the effects of mining activities on environment and wildlife species. DR Congo plays key role on

world market as supplier of strategic metals such as cobalt, industrial diamond, Colombo-tantalite, oil, and copper. However this country has low growth rate of gross domestic product (GDP) and high poverty and inequality. Our historical analysis shows that availability of mineral resources itself does not always assure economic development.

Materials and Methods

We used two approaches in this study. First, for economic analysis, we collected primary and secondary sources on fieldworks in DR Congo in February 2011, March 2012 and September 2012.

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In addition, we also interviewed managers of two main mining companies, La Societe de Developpement Industriel et Minier du Congo (Sodimico) and La Generale des Carrieres et de Mines (Gecamines). Second, for environmental pollution, we used data and laboratory results given by the Provincial divisions of mines and environment. The analysis of metals was conducted with the "Spectrometric of Atomic Emission" manufactured by ELMER OPTIMA 2100 DV, and the PH and TDS by the METTLER TOLEDO.

Economic aspects of copper industry in Katanga

It is important to review the background of the copper industry, its importance in Katanga, the trend of output, and its economic contribution.

Background of copper industry in Katanga

The local people in Katanga had known technique of copper extraction with traditional instruments before the arrival of Europeans. During the late 1890s the Belgian King Leopold II sent geologists to prospect the land of Katanga. The geological report gave confidence to Belgian King about the financial issue. Indeed, the exploration of the area by the Belgian geologist Jules Cornet in 1892 led to the discovery of mineral resources in industrial quantities². Katanga copper belt is the Congolese part of the well-known Central African copper belt, the largest sediment-hosted strati form copper-cobalt province on earth³. The industrial activity of copper production has started early in the twentieth century by the Union Miniere du Haut Katanga², the Belgian colonial company. After the independence, in 1967 the company was nationalized by the Congolese government to create the new firm named La Generale Congolaise de Minerais (Gecommin). Then it became La Generale des Carrieres et de Mines (Gecamines) in 1971.

The biggest achievement of Belgian Congo period was the creation and growth of the mining company, the Union Miniere du Haut Katanga to exploit the new opportunities of copper and cobalt in Katanga². The firm began to extract copper in 1911. During the First World War of 1914–1918, Germany has occupied large territories of Belgium. On request of Belgian government, the Belgian Congo mobilized military forces to fight together with Belgian army⁴. By 1928, the Union Miniere du Haut Katanga was producing 7% of the world's total output of copper. In the 1930s, further explorations of the colony were accomplished. In 1934, the uranium mine of Shinkolobwe was opened⁴. In 1939, the American diplomacy negotiated the importation of uranium ores from Congo. In 1941, the stock of uranium kept in New York helped to make the atomic bomb dropped in the two Japanese cities of Hiroshima and Nagasaki in 1945⁴.

Some years after the Independence of Congo, in 1967, President Mobutu decided to take the control of land, natural resources and mining areas as government properties⁵. Five years later in October 1971, President Mobutu started the political campaign called "the return to authenticity" which emphasized the African identity of his nation by his political ideology⁶. The economic role of copper industry is reviewed in the following paragraph.

Importance of copper industry in Katanga

The Congolese economy has been mainly of subsistence up to the colonial era⁷. The First World War decreased the economic performance of the Belgian Congo. Copper became a strategic product for military equipment during this war period. A ten-year plan for the national economic and social development was started in 1949 after the Second World War⁸.

The Congolese copper industry has been dominated by two companies, the Generale des Carrieres et des Mines (Gecamines) and La Societe de Developpement Industriel et Minier du Congo (Sodimico) which monopolize the

total output of Congolese copper and cobalt. Throughout the Congolese history, the mining sector has constituted the cornerstone of Congolese wealth since the colonial period. Mining industry has been the most important source of foreign exchange and government budgetary support. In the late 1980s, DR Congo was the world's largest producer of cobalt, the third largest producer of industrial diamonds, and the fifth largest producer of copper⁹.

In terms of quantity of copper output, Gecamines takes the leading position as a government-owned enterprise founded after the independence in 1967 to replace the former colonial company, the *Union Miniere du Haut-Katanga*. Gecamines produces about 90 percent of the country's copper and total output of cobalt, zinc, and coal. The second enterprise is "La Societe de Developpement Industriel et Minier" (Sodimico), which mines the remainder 10 percent of copper output.

Copper production in Katanga

On 28 October 1906 Leopold II signed the decree creating the Union Miniere du Haut Katanga (UMHK)¹⁰. This event was a mystery in Katanga because the king Leopold II wished to keep secret his projects in Congo to avoid competition with other Europeans⁴. The capital of the company was composed by 100,000 shares of 100 Franc divided between "La Societe Generale de Belgique" and the Tanganyika Concessions Limited as shareholders⁴.

The general trend of output of the Union Miniere du Haut Katanga was increasing from 980 tons recorded in 1911 reaching 320,000 tons of copper metals per year at the nationalization of the company by Congolese government in 1967¹¹. About ten percent of copper output is consumed on the local market while the remainder ninety percent is exported. Les Lamonieres et Trefileries de Lubumbashi and the Cablecom have been established to manufacture the final products of copper for the local market. These plants located in Lubumbashi are specialized in

copper processing to produce layton and alloys. They produce cables for electrical installation and transportation.

It is important to recall that after the independence of the country, by law of 7 June 1966, the central government of Congo decided to take over all concessions granted to foreign firms under the colonial regime⁵. In fact, the Congolese government became the sole owner of concessions, forest, and mineral resources¹². The Gecamines was created on 2 January 1967 by expropriating the Union Miniere du Haut Katanga's assets as a state owned company in DR Congo with headquarters in Lubumbashi¹³. Copper and cobalt are the main products produced by Gecamines in Katanga province, the southern part of the DR Congo. Gecamines maintained a high-level of output after the nationalization, thanks to technical assistance provided by the Belgian firm the Societe Generale de Minerais, in agreement with the Congolese government.

The output of Gecamines reached the pick in 1974 with 479,000 tons of copper metals¹⁴. Then a sharp decline of production was observed in 1994 with 29,300 tons of copper¹⁵. Political instability related to the instauration of democracy in DR Congo in April 1990 had negative effect on the management of Gecamines. In addition, the company was running out of financial resources that destabilized its performance, resulting into decline of production. During the same period, a total of eight thousand work forces including managers and workers resigned from the firm because of the ethnic conflict in Katanga. In 1990s the big firm in Katanga, Gecamines put knees on ground as result of socio-economic and political crises in the country. The reserves of Gecamines are still important and economically profitable. Gecamines signed partnership contracts with national and multinationals companies for exploitation of owned concessions and infrastructures.

Economic contribution of copper industry

In contrast to other African countries for

which agricultural sector is the main source income, the Congolese economy relies on copper industry as key sector to generate income for national development. The contribution of copper industry to GDP, for years for which the data are available in constant Congolese Franc from 1952–1959 and constant dollar from 1965 to 2011, shows a stable contribution of the copper industry to the Congolese GDP of 17 percent during the 1950s. This share of copper industry declined in 1958 due to the withdrawal of Belgian investment from Union Minière du Haut Katanga in Belgian Congo¹⁶. From 1966 to 1970 the copper industry became the main source of income with 57 percent of GDP the highest rate accounted in 1966. During the 1970s and early 1980s the copper industry remained the key sector of Congolese economy with contributive capacity accounted about 30 percent of GDP. The collapse of output of Gécamines in 1990s had negative impact on importance of copper industry to GDP which dropped to 2 percent in 1994¹⁷.

The recent output recovery

From the mid-1990s the output of copper companies collapsed as shown above. The two big producing companies of copper and cobalt adopted joint venture management to revitalize the output. These firms signed contracts with new investors interested in exploitation of their facilities, mines, equipment and plants.

On one hand, Sodimico has signed partnership contracts with investors who are interested in small mines and small deposits such as Mabaya, Kapapa, Kimpe, and Lubembe. Since the collapse of production up to date there is no partnership contract for Musoshi mine. The Kinsenda mine is exploited by a South African company which signed a partnership contract. In 2010, an Australian company was negotiating the contract with Sodimico to exploit the wastes of Musoshi concentrator estimated for about 20 million tons. On the other hand, Gécamines signed contracts with investors willing to use its concessions, mines and plants. The selection of partners is

done through a bidding system. Partners have to submit their propositions to the company after pre-feasibility study. There is a committee formed by representatives of the ministry of mines, experts of Gécamines and the bidders willing to exploit the mines or plants in partnership with Gécamines.

Since 2006 the copper industry was recovering in Katanga. The output of cobalt and copper accounted for 108,888 tons and 522,133 tons respectively in 2011¹⁸. During this recovery period, some cases of toxicity and pollution have been reported into mining industry. The toxicological aspect is reviewed in the next section.

Toxicology and pollution in Katanga

This paper focuses on five metals including copper (Cu), cobalt (Co), lead (Pb), zinc (Zn), and cadmium (Cd) for which concentration level is above the curve standard. The contamination of water, soil, plant and fish is caused by mining activities. Although the law sets the thresholds of heavy metals to discharge into nature, the copper industry remains the main source of pollution because of heavy metals discharged into rivers of the province.

Environmental legislation

The copper producing companies in Katanga had not paid much attention to the environmental protection before the early 1990s. The World Bank and the International Monetary Fund required copper companies to put in place measures for environmental protection as criterion to borrow from these financial institutions. In response to this requirement, in 1992 Gécamines created a service for control of environmental pollution. In 1998 the division of environmental pollution and protection replaced the previous service.

At national level, the legislation of the mining industry Journal¹⁹ (Code Minier 2002

and Reglement Minier 2003) requires mining stakeholders to integrate the environmental pollution and protection at all stages of their activities Journal²⁰. In addition, companies are requested at the beginning of their activities to conduct Environmental Impact Study (EIS) for the reduction and prevention of environmental pollution²¹ (Environmental regulation July 2011). Although the legislation sets standard of heavy metals to be discharged into nature, some cases of pollution have been recorded in the copper industry.

Toxicity in Katanga due to mining industry

The use of chemicals into mineral extraction and processing has been the main source of toxicity for wildlife species and water contamination in rivers of Katanga. The industrial waste (liquid or solid) is discharged into rivers, soil and air. The contamination of water has killed fishes in ponds held by villagers around Kipushi located about twenty kilometers from Lubumbashi, where companies process minerals. The local media informed the people to be aware of water contamination for living species (human, fishes, and plants). The provincial coordination of environment made sampling of water, soil and fish for laboratory analysis. The analysis of samples at the Congolese Office of Control Laboratory measured the degree of contamination by heavy metals from mining activities. The next section discusses the results of heavy metal contaminants of rivers and soil around Lubumbashi city.

Analysis and Results

The analysis of sources shows that the extraction and metallurgical processes in mining industry use important chemicals which pollute the environment. The analysis of water shows that 0.68 ppm of nickel, 5.22 ppm of cadmium, 0.5 ppm of lead, 6.80 ppm of cobalt and 1.41 ppm of copper. The high concentration of lead and

nickel is harmful to human and wildlife lives. The cadmium level is higher than the international standard at many points of sampling. The pollution of water in Kafubu River harms both fishes and other living species in water.

Besides, heavy metals have contaminated the soil around rivers. The analysis of soil shows the concentration of 35.88 ppm of cobalt which is the main contaminant element of the soil; 5.62 ppm of copper; 5.57 ppm of lead, 2.74 ppm of nickel and 4.20 ppm of cadmium. The five metals contaminate the soil around Kafubu River. Seven points for sampling soil show that heavy metals (Cu, Co, Ni, Cd, and Pb) are contaminants of soil around rivers. Since the agriculture is the principal economic occupation in this region, this pollution affects negatively the productivity and the quality of agricultural products. These agricultural products are also sold on in Lubumbashi.

The analysis of fish caught in Kafubu River in May 2011 shows the concentration of metals. The concentration level of 45.54 ppm of cobalt and 33.56 ppm of copper in fish is above the international standard. This confirms the pollution of environment by the mining industry in Katanga province. In addition, the concentration of 25.28 ppm of nickel, 0.042 ppm of lead and 13.26 ppm of cadmium show high degree of contamination. These metals cause toxicity to fish. More investigations should be conducted to determine the effects of metals contamination of human being.

The analysis of plant shows the concentration of 293.68 ppm of cobalt, 24.64 ppm of copper, 69.95 ppm of nickel, 354.72 ppm of cadmium and 214.48 of lead. There is evidence that heavy metals affect negatively the environment in Katanga province.

The above results in comparison to both Congolese and international standards show the evidence that heavy metals are contaminants that pollute the environment. This paper provides more scientific evidence about contaminants of

soil, water, fish and plant.

Conclusion

This paper shows that mining projects have positive and negative impacts on economy, society and environment. The result of samples analyzed shows the evidence that mining industry is the main source of environmental pollution in Katanga province of DR Congo. The five heavy metals analyzed have concentration levels above the standards in soil, water, plant and fish in Katanga province during the period of study. The recovery of output is good signal for economic growth. This recovery trend, however, hides environmental degradation that affects negatively the living species around the mining sites. New policies that focus on clean deals should be implemented in DR Congo to achieve economic growth without compromising the quality of environment. Further research on impact of heavy metal contaminants on human being in Katanga should be a new area of investigation.

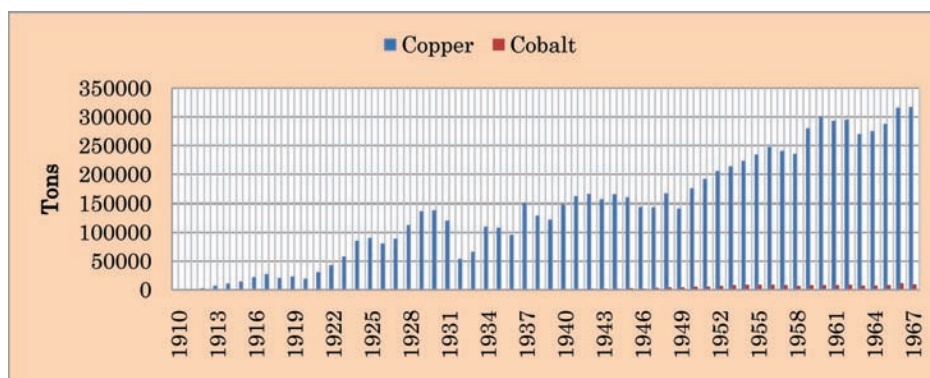
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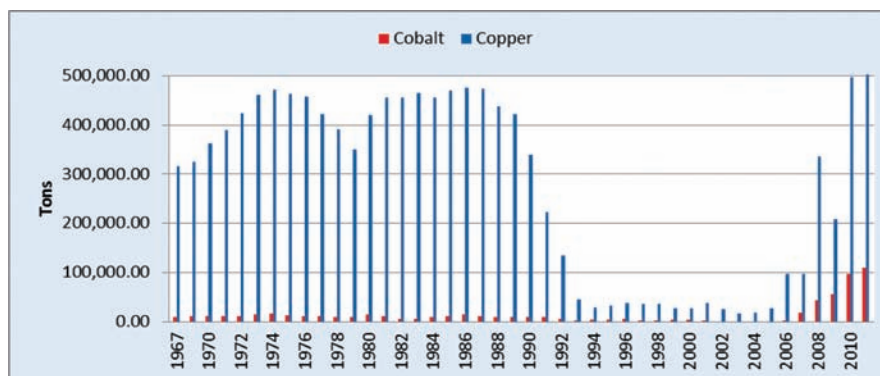
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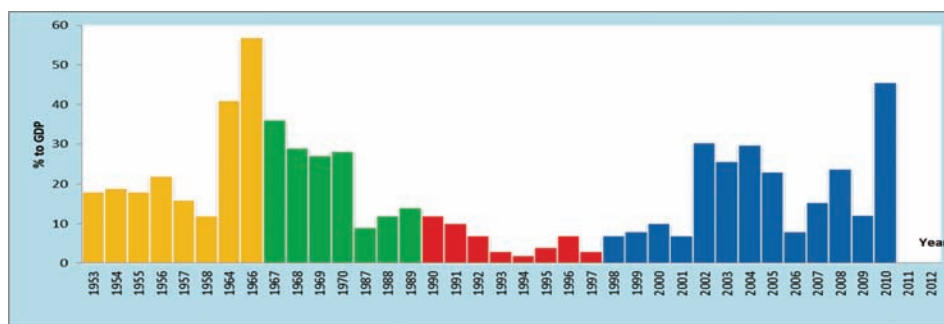
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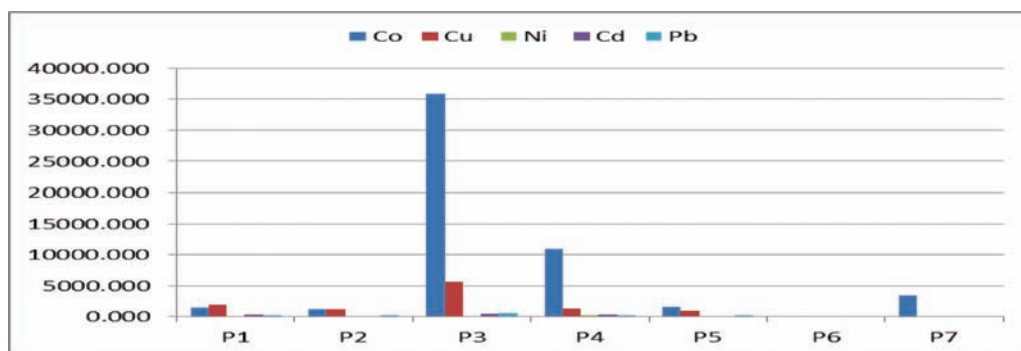
Graph 1. Production of copper and cobalt by UMHK from 1910–1967. Source: Republique du Zaire, Mobutu Sese Seko de 1965–1975, p.44.



Graph 2. Total output Gecamines and partners 1967–2011. Source: Author using data from Annual Reports of Gecamines 1967, 1985, 1996 and BCC 2006–2010.



Graph 3. Share of Copper Industry in GDP 1953–2011. Source: Author using data provided from Nyembo Shabani¹ and various Annual Reports of Gecamines and BCC². 1) Nyembo Shabani, *L'industrie minière dans le monde et le développement économique du copper belt African*, Bruxelles, La renaissance du Livre, 1975, p.137. 2) Gecamines Annual Reports 1987–1995 and Annual Reports of Central Bank of Congo 1990–1995, 207–2010.



Graph 4. Concentration of metals in Soil around Kafubu River in ppm. Source: Data from Report on Kafubu River pollution July 2011 and Report of Provincial Division of Environment on pollution in Lubumbashi and Kipushi October 2011.

Table 1. Result of Kafubu River water analysis May 2011

Sampling point	PH	Co ppm	Cu ppm	Ni ppm	Cd ppm	Pb ppm
P1	5.38	5.3687	0.6145	0.6044	3.7589	0.2963
P2	6.66	6.8068	0.8145	0.5251	2.5265	0.375
P3	6.43	0.8878	0.9112	0.6615	5.0461	0.0101
P4	6.42	1.2749	0.0378	0.6868	5.1329	0.5402
P5	6.88	8.0134	0.0978	0.3256	3.1394	0.01
P6	6.71	1.4228	0.0567	0.0284	0.9927	0.1215
P7	7.12	0.6716	0.0126	0.06	0.2305	0.3171
P8	6.86	2.1058	0.001	0.1264	0.0486	0.3462
P9	7.58	0.535	0.0189	0.0663	0.0486	0.1007
P10	6.34	1.4456	1.4135	0.4586	5.2205	0.133
P11	8.73	0.2504	35.5	0.1106	0.01	0.3462
P12	7.56	0.0341	0.022	0.0033	0.0141	0.1649
P13	7.7	0.2618	0.0441	0.1106	0.0389	0.0677
P14	7.94	0.0228	0.157	0.0568	0.0133	0.677
P15	7.73	0.0000	0.1042	0.1011	0.0912	0.0171
P16	7.33	0.0569	0.0409	0.0256	0.5927	0.5927
P17	7.55	0.0228	0.0409	0.12	0.0301	0.0244
P18	7.64	0.0091	0.0852	0.1137	0.0283	0.133
P19	7.9	0.3529	0.0725	0.0632	0.0362	0.2875
Congolese Standard	6 ~ 9	1*	1.5000	0.02*	0.5000	0.5000

* Canadian standard

Source: Data from Report on Kafubu River pollution July 2011 and Report of Provincial Division of Environment on pollution in Lubumbashi and Kipushi October 2011.

Table 2. Result of Plant analysis

Sampling point	1
Weight	0.5 gr
Co	293.68
Cu	24.64
Ni	69.95
Cd	354.72
Pb	214.48

Source: Data from Report on Kafubu River pollution July 2011 and Report of Provincial Division of Environment on pollution in Lubumbashi and Kipushi October 2011.



Map of Kafubu River. Source: Institut Geographique du Congo, Lubumbashi.



Dead fishes at Mapongo village.