THE RELATIONSHIP BETWEEN THE BAUXITE INDUSTRY AND THE AGRICULTURAL SECTOR IN JAMAICA

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Introduction

The bauxite industry is currently the only primary extractive metallurgical industry in the country. Since its inception in 1952, it has grown to be the largest sector of the economy, and has maintained this position since 1969 (Figures 1 & 2). More than that, however, it is a major natural resource, taking its rightful place along with land and labour, and can provide a vehicle to bring with it the other important factors of production, capital and technology. This is necessary in the industrialization of the island for economic development. This development of mineral resources and the bauxite alumina industry in particular, may involve competition with other industries like agriculture for land, labour and capital, but, at the same time, it can provide market opportunities for agricultural products (see Table 1). It is necessary to analyse all of these opportunities to determine what is in the best interest of the island and phase any changes, which are necessary, to avoid short-term dislocations because of any transition.

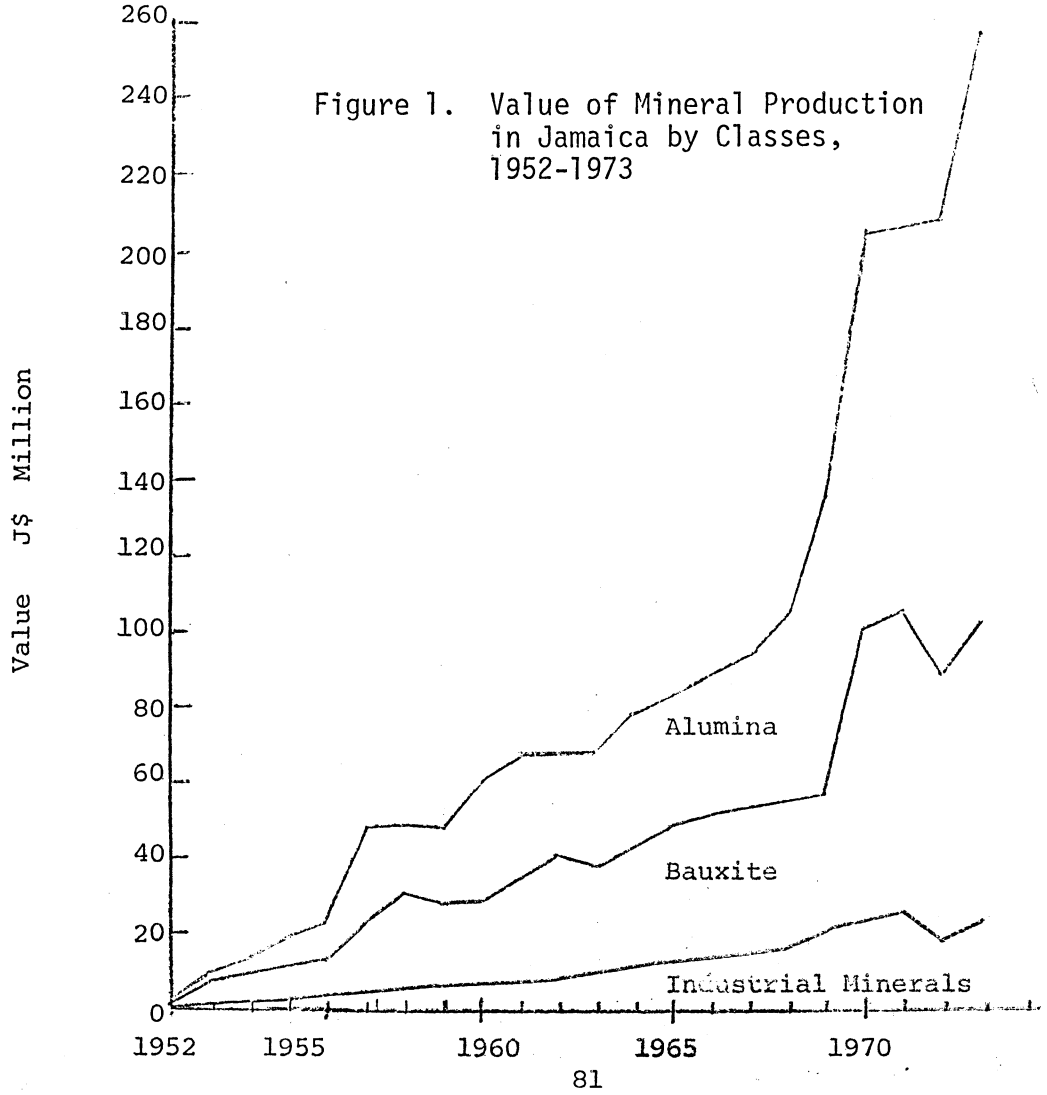
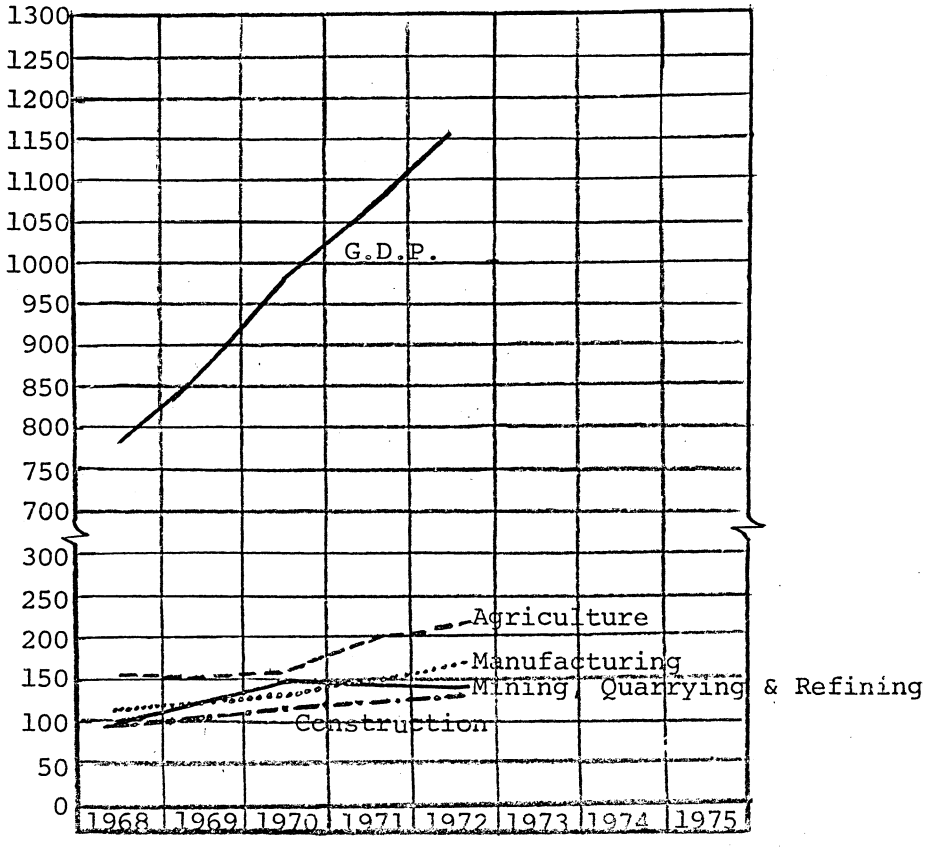


Figure 1. Value of Mineral Production in Jamaica by Classes, 1952-1973

Table 1. Major Land Use Data, Jamaica, (Acres)

	(Acres)
Bauxite Industry:	
Plant site, buildings, railroads, etc.	9,151
Current & Estimated Mining over the next five years	20,207
Tenant (and non-rent tenants)	58,395
Lessees	17,910
Resettlement	6,659
Other	4,526
Crops:	
Orchard	504
Cane	600
Roots (tubers)	125
Forestry	34,289
Pasture	33,614
Other	447
Livestock (fenced animals)	25,585

Figure 2. Contribution of Main Sectors to G.D.P.



Bauxite like other minerals has no real inherent value when simply left in the ground. It is only through exploitation that it becomes valuable. Furthermore, the income obtained should preferably be invested to create new sources of income for future citizens.

Another concept which must be analysed is the often repeated claim that minerals are a depleting asset. This is a misunderstanding of the fact, since reserves grow through the application of science and technology to exploration and development. This does not suggest that all minerals will retain their current levels of production, markets and prices to consumers. Commodities like aluminum are major constituents in the earth's crust as to permit considerable expansion of production, so will continue to remain as the principal metals even into the distant future. In contrast, commodities such as mercury, tin, silver, gold are pressed to maintain their current production and markets. Their prices to consumers are rising rapidly, and consequently, substitutes are being sought. Alternately, lower grades of ore will be mined and metals extracted from minerals which in the past were not amenable to extraction depending of course on cost relative to substitutes. Costs in the mineral industry reflect both on the energy input and the human resources input.

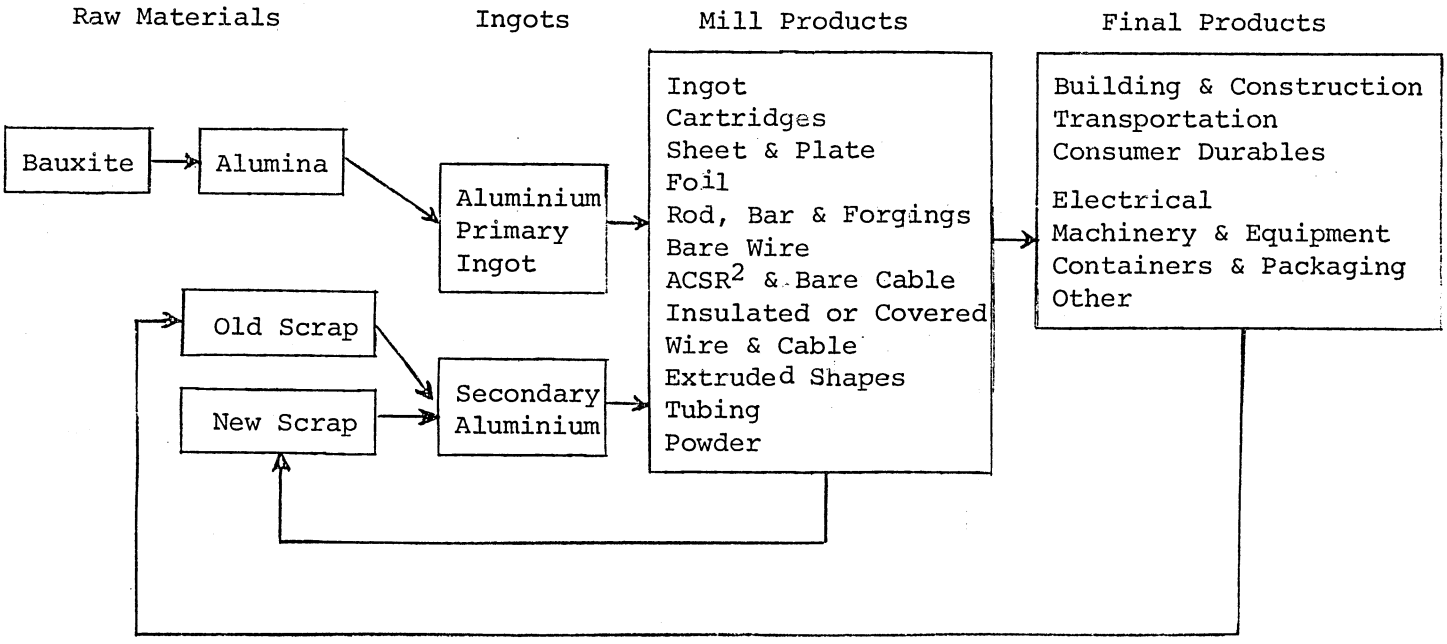
The world aluminium industry had it birth in 1886 and until the end of World War II, was dominated by the Aluminium Company of America in the Western Hemisphere and Pechiney in Europe, as vertically integrated operations. During the post-war period the industry became less concentrated and by 1969, about 77 per cent of the industry was split among six integrated firms and the remainder divided among several dozen much smaller concerns, many of which were not integrated. The industry has been divided into four distinct stages: bauxite mining, alumina production, reduction of alumina to metal and fabrication (see Figure 3).

Metallurgical grade bauxite ore is a rock consisting of aluminium oxyhydroxides which can be mined and processed into aluminium at a profit. Three principal types of metallurgical grade bauxite are recognized, i.e. Jamaican, Surinam and European. These basic types of ore require somewhat different Bayer process technologies in terms of digest temperature and mud separation techniques. Bauxite mining is the least costly of the three stages. It requires between 4-6 tonnes to produce 1 tonne of aluminium, or 10-15 per cent of the cost of production of ingot.

Alumina processing involves the separation of alumina from the bauxite to give a product which is 99 per cent pure alumina. Variations of the Bayer process are used to extract alumina from bauxite. It involves the digestion of the alumina from the ore followed by decantation and filtration of the digest product, precipitation of hydrate and its filtration, washing and ignition.

Aluminium is produced from alumina by electrolysis using the Hall-Heroult process. At present plants in commercial operation use either the prebaked or Soderberg anode systems. The product is cast into ingots which are usually 99.5 per cent pure and usually alloyed with other metals and then fabricated. The aluminium cycle (Figure 3) also includes the production of metal from new and old scrap. This secondary aluminium smelting is usually conducted by independent operators.

Figure 3. Flow Chart of the Aluminium Market



There are potential sources of aluminium besides bauxite and other extraction processes besides the Bayer: Hall-Heroult process. Bauxite will, however, maintain its extraction costs advantage over that of other potential raw materials unless transport costs become abnormally high, or there are abnormally high increases in the cost of this ore. Any new aluminium extraction technology developed will be even more applicable to bauxite ore than substitutes.

The Local Industry

Ore Reserves

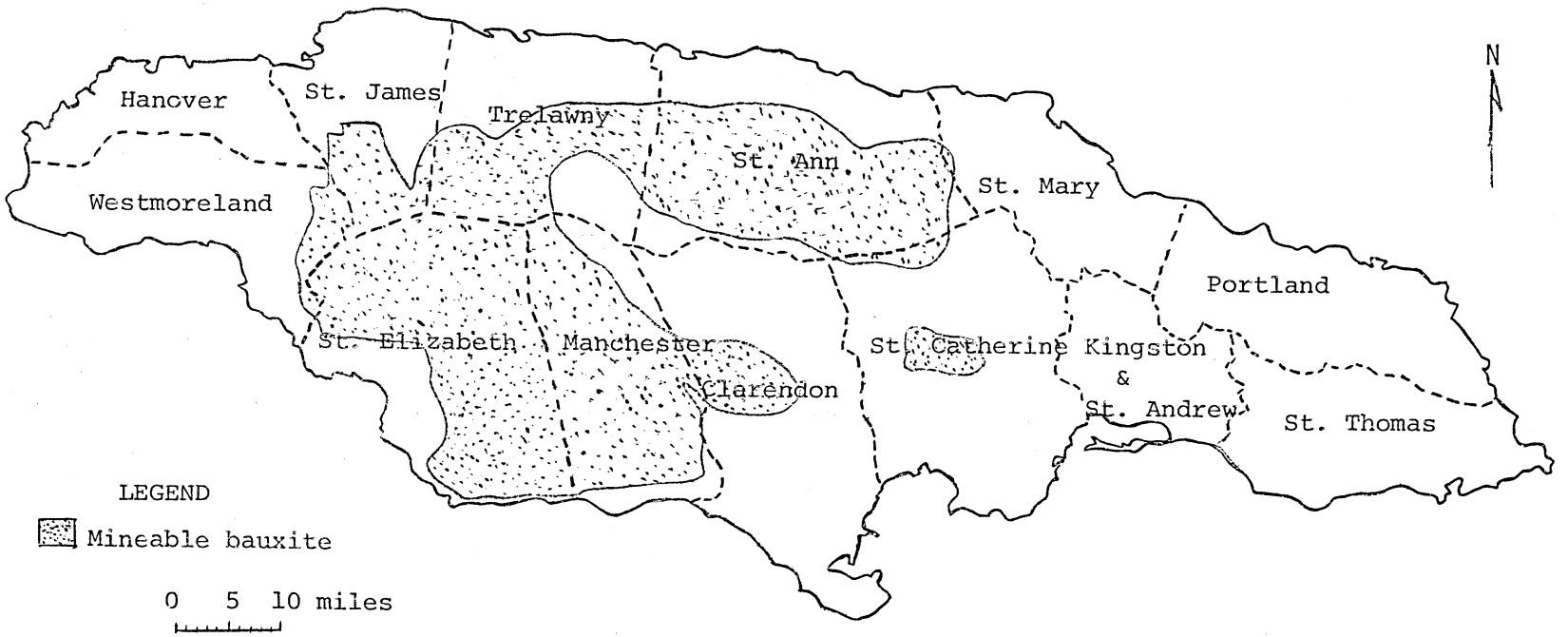
The bauxite deposits in Jamaica occur as solution cavity infillings in the White Limestone karst regions of the island (Figure 4). Based on statistical difference in the distribution of their silica-alumina values, the major classes consist of (i) plateau or undisturbed bauxite (Cockpit or youthful karst type, and mature karst type), and (ii) graben or partially disturbed bauxite (partially reworked, and partially reworked and contaminated).

A further refinement can be made which is directly correlatable to mineral composition. These different types of bauxite require somewhat different technologies. The bauxite reserves of Jamaica have steadily increased since 1941, in spite of increased mining, and today the reserves are several times greater than they were in 1951.

Operations

Tables 3 and 4 indicate the bauxite ore and alumina production facilities and also shows their location and concessions. Table 5 shows the capital investment in the island and Table 6 the detailed breakdown of production for 1968-73.

Figure 4. Mineable Bauxite; Jamaica



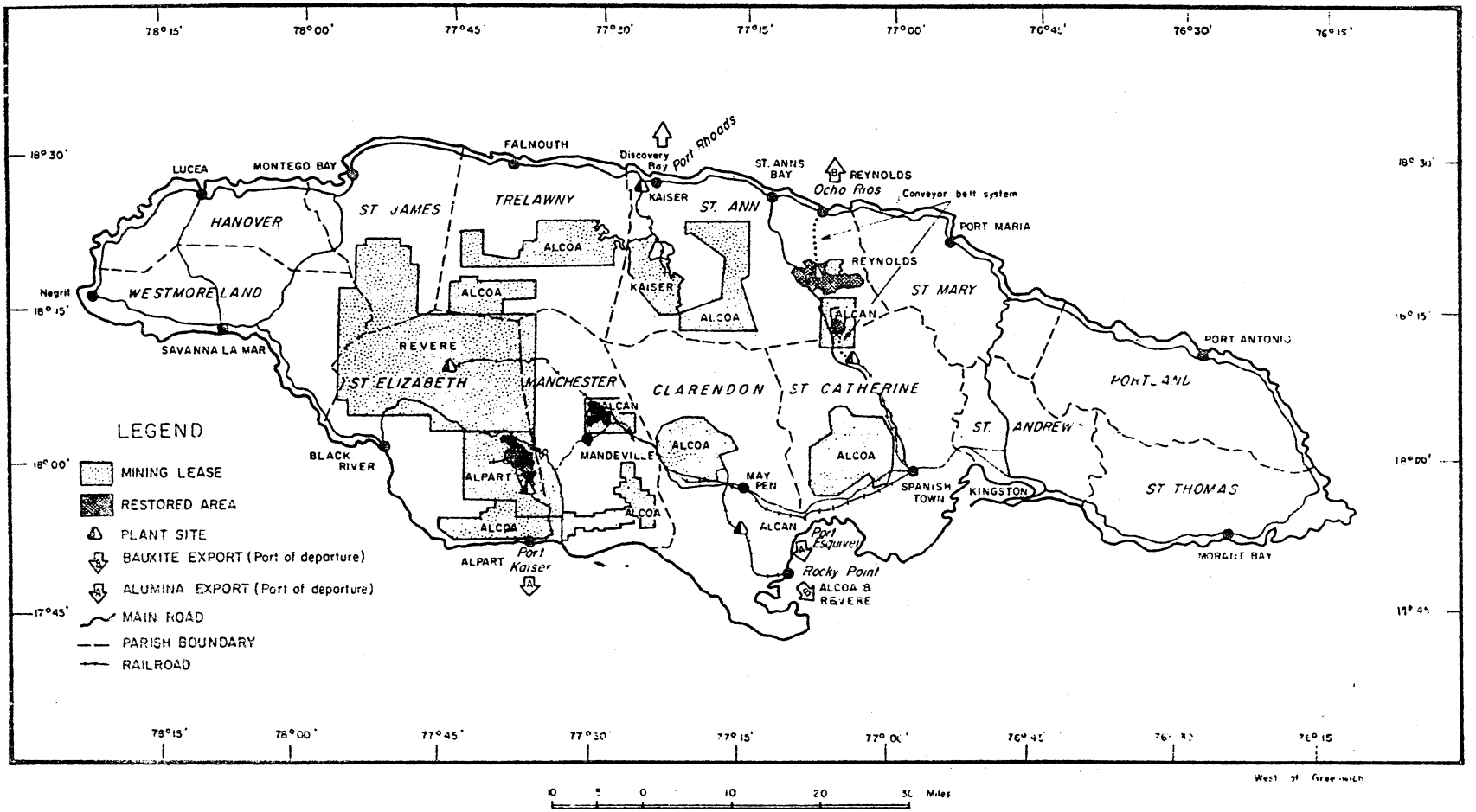


FIG. 5 BAUXITE AND ALUMINA INDUSTRY MAP

Table 2. Land Owned by Bauxite Companies

Parish	Total Acreage (Acres)
Manchester	62,279
St. Elizabeth	34,667
Clarendon	7,321
St. Catherine	2,186
St. Ann	76,767
Trelawny	14,934
St. James	53
Total	198,207

Table 3. Bauxite Ore Production and Export Facilities

Company	Parent Company	Location of Operations			Rated Annual Capacity (mMt)*
		Mining	Plant Site	Port	
Alcoa Minerals of Jamaica	Aluminium Co. of America	Mocho Mountains	Woodside	Rocky Point	1.2
Kaiser Bauxite Co.	Kaiser Aluminium & Chemical Corp.	Dry Harbour Mountains	Discovery Bay	Port Rhoades	6.0
Reynolds Ja. Mines	Reynolds Metal Co.	Lydford	Lydford	Ocho Rios	3.2

Note: * mMT = Million metric tonnes.

Table 4. Alumina Operations in Jamaica

Company	Parent Co.	Location of Operations			Rated Annual Capacity ('000 MT)
		Mining	Plant Site	Port	
Alcan (Jamaica) Ltd.	Aluminium Co. of Canada	Shooters Hill	Kirkvine	Port Esquivel	558.8
		Schwallen-burg	Ewarton	Port Esquivel	558.8
Alumina Partners of Jamaica	Partnership between Anaconda Co., Reynolds Metals Co., Kaiser Aluminium & Chemical Corp.		Nain	Port Kaiser	1330
Revere Jamaica Alumina Ltd.	Revere Copper & Brass Co. Ltd.	Maggotty	Maggotty	Rocky Point	200
Alcoa Minerals of Jamaica Inc.	Aluminium Co. of America	Mocho Mtns.	Halse Hall	Rocky Point	500

Table 5. Total Capital Investment in Jamaica by the Bauxite/Alumina Companies; 1969-72

	Capital Investment				
	Total 1969*	1970**	1971**	1972**	Total to 1972
Bauxite Mining & Drying	96,780,914	55,132,762	40,756,884	66,332,762	259,003,322
Alumina Production	310,396,195	26,108,559	18,536,977	11,618,241	366,659,792
Grand Total	407,117,109	81,241,321	59,293,861	77,951,003	625,663,294

Notes: * Obtained from Companies
** Annual Return under Regulation 54.

Figures 6 and 7 show the bauxite production statistics for 1952-1973, and Table 6 gives the detailed breakdown of production for 1968-1973.

Fig. 6. Histogram of Metal Grade Bauxite Production in Jamaica

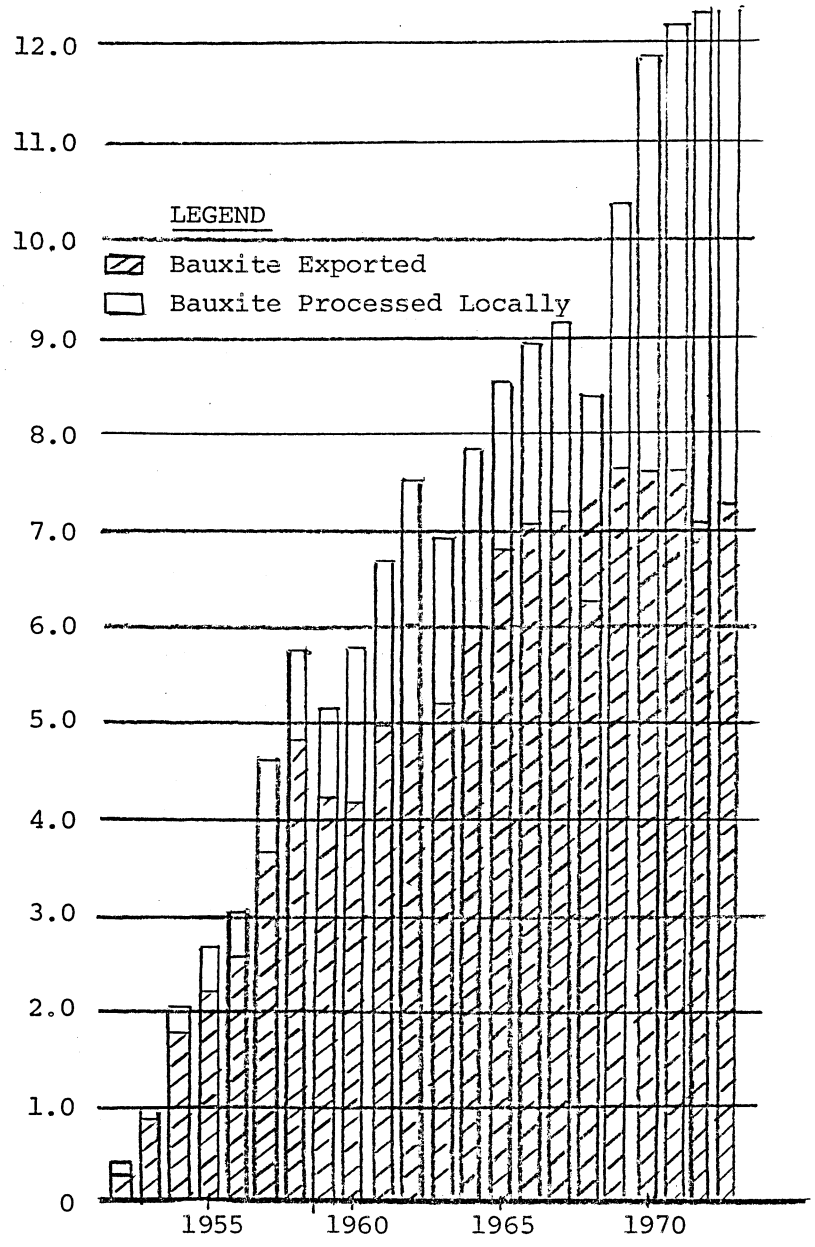
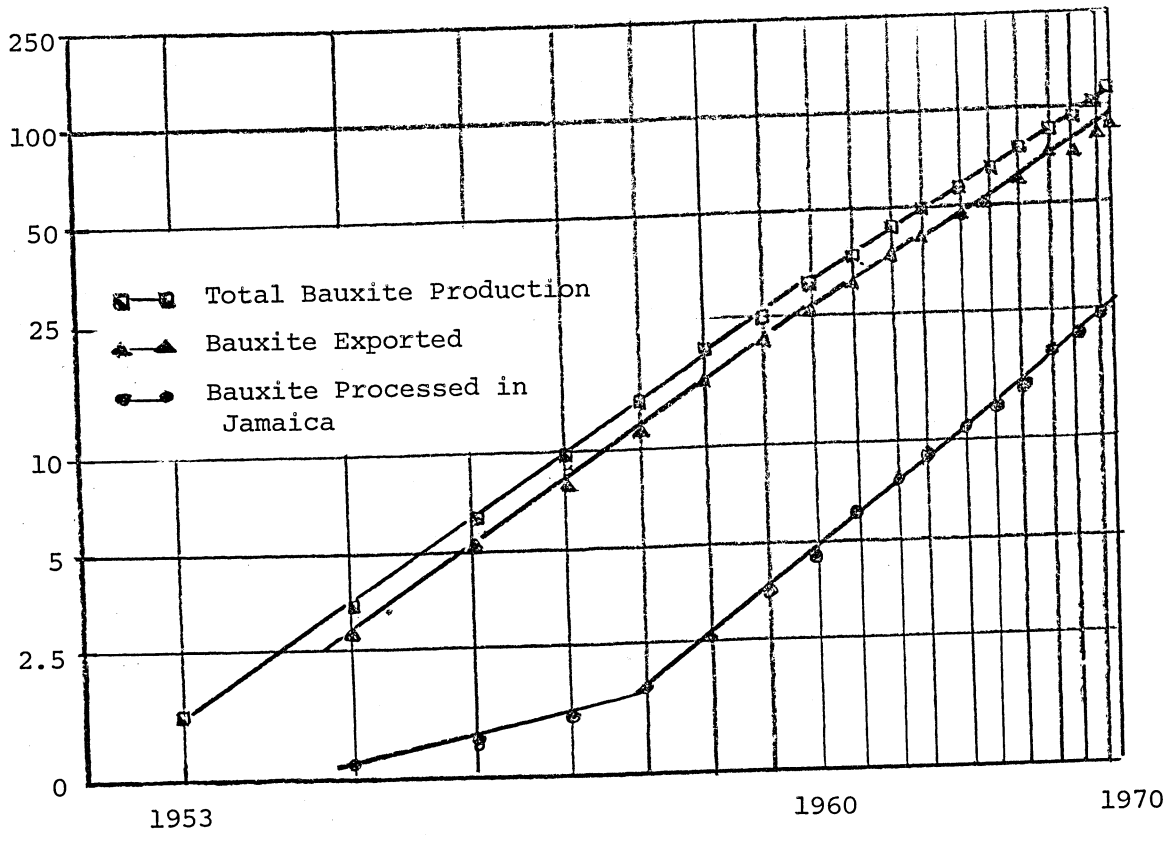


Fig. 7. Cumulative Bauxite Production in Jamaica



Source: Department of Mines, Kingston 6, Jamaica.

Table 6. Bauxite Ore Statistics

('000 Metric Tonnes)

	1968	1969	1970	1971	1972	1973
Jamaica:						
Bauxite Ore Mined	8,195	10,260	12,111	12,193	13,452	n.a.
Kiln Dried Production				7,636	6,737	7,020
Export	6,312	7,723	7,697	7,712	7,162	7,020
Locally Processed	2,214	2,775	4,313	4,729	5,377	7,579
World Production	45,981	52,611	57,830	63,103		

Trade:

Exports of bauxite and alumina for 1972 were valued at J$70m. and J$131m. respectively, and represented about 60 per cent of total Jamaican exports for the period. Metallurgical grade bauxite ore was mainly shipped to the United States of America. North America, Norway and the United Kingdom were the main recipients of Jamaica's alumina exports (Table 7).

Table 7. Alumina Export Sales and Value by Countries of Destination, 1972

	Tonnes	% of Total	Value (J$'000)
North America:			
U.S.A.	676,252	35.8	47,299
Canada	204,467	10.8	13,661
Latin America:			
Venezuela	14,733	0.8	1,214
Trinidad	187	0.01	16
Europe:			
Iceland	46,034	2.4	2,993
Norway	462,089	24.5	29,614
Spain	60,320	3.2	3,888
Sweden	132,920	7.0	8,286
U.K.	291,895	15.4	20,754
TOTAL	1,888,897		127,725

The United States of America is the principal importer of Jamaican bauxite, and an increasingly important market for alumina. Jamaica supplies 60 per cent of the U.S. bauxite market. However, its share of the U.S. Alumina market is not yet clear, because the distribution of the production from Alpart has not yet been stabilized.

Inputs into Alumina Production

Table 8 gives the various inputs involved in the production of alumina in Jamaica.

Table 8. Inputs into the Production of One Tonne of Alumina

Inputs	Quantities
Labour	3 man hrs.
Capital (cash)	J$20
Bauxite (land)	2.4 - 2.8 tonnes
Energy	20m. BTU
Soda	80 kg.
Lime	70 kg.
Flocculant (starch)	15 kg.
Water	

Labour:

Table 9 gives the employment requirements of the industry for the period 1969-1972.

Table 9. Employment Statistics of the Bauxite/Alumina Companies, 1969-72

Mining, Processing & Related Activities	4,734	5,107	6,162	5,393
Construction	2,949	5,910	3,938	1,530
Administration	n.a.	n.a.	n.a.	794
Agriculture & Agricultural Processing	1,975	1,937	1,145	1,233
Others	521	306	-	659
TOTAL	10,179	13,390	11,243	9,519

The approximate number of Jamaicans and non-Jamaicans involved in the industry at the senior levels are given in Table 10.

Table 10. Approximate Number of Senior Personnel Employed in the Bauxite/Alumina Industry of Jamaica, 1973

	Jamaican	Non-Jamaican	Total
Management (Exec./Top)	15	23	38
Management (Middle)	26	27	53
Professional	230	100	330
Technical	500	40	540
TOTAL	771	190	961

The personnel involved mainly have training in chemical, mechanical, industrial, electrical, civil and mining engineering. Most of these areas are in short supply in the island and so there is need for a concerted effort to develop people with the necessary training and experience to meet the requirements of the industry. The industry must provide employment for many of these persons, who will become the nucleus of a cadre of technologists. The spin-off of this must positively affect agriculture. This has already started. It must be pointed out that the mineral industry has fairly stringent requirements of its personnel, so that it can meet the challenges which arise.

In addition to having the minimum experience requirement, supervisory personnel must have some international experience to broaden their base and must also show a capacity to manage. At the professional level, the personnel requirements of the industry do not pose a significant competitive problem with agriculture, but with the manufacturing and construction sectors. However, experience with the efficient operations of heavy equipment could prove beneficial to agriculture in its drive to mechanize in order to reduce costs. The only real area of competition is wage rates, since the mineral industry pays a significantly higher rate than does agriculture. An analysis of the situation however, shows that even here the result could be beneficial, since there is constant need in the industry to reduce operating costs as wages increase, that is, to increase the per man output. This is a policy which agriculture and other sectors of the economy would do well to copy.

On the other hand, agriculture is at a distinct disadvantage in the technical and skilled labour categories. This is because the bauxite industry is capital intensive and a high wage sector, in contrast with the labour intensive low income agricultural sector. In the competition for labour therefore, the agricultural sector is at a disadvantage. By drawing on the same labour market, the bauxite industry increases the reserve price of labour in the immediate and adjacent communities. Those who offer their services to the agricultural sector demand a higher wage

scale, while given the general contempt held for manual work and agricultural in particular, a bauxite labourer ranks higher in the social strata than an agricultural labourer. Hence, potential agricultural workers who fail to gain employment in the bauxite industry often go unemployed rather than opt for agriculture.

Given the fact that the Jamaican small farmer is the major supplier of domestic foods, dislocation in this subsector will tend to reduce his productivity, thereby contributing to the country's increasing food import bill. Consequently, there should be a smooth shift in land use which should reflect the change in composition of demand in favour of certain types of foods.

Capital

Capital investment in Jamaica by the bauxite/alumina companies (Table 4) were raised outside Jamaica, specifically for the industry. These would not have been invested in the island if the industry did not exist; thus, there is no conflict of interest between agriculture and the bauxite industry in this area. In fact, agriculture has benefitted by the spin-off from the industry, since, under the Mining Legislation, the companies are obliged to at least maintain the same level of agricultural productivity, prior to and after mining. In this, their investment in cattle farming and meat processing is well known.

Relationship between Land and Mining

Metallurgical grade bauxite ore is vested in the Government under Section 2(a) of the Minerals (Vesting) Law, Chapter 251 of 1947. The surface right however belongs to the owner of the *fee simple*. Since mining and ancillary operations will interfere with the exercise of the surface rights, the problem becomes one of sequential multiple use.

During the early stages of bauxite mining in Jamaica, mining was almost entirely confined to large properties, which could be readily acquired by the companies, and Mining Leases issued for each. Later, exploration by Kaiser Bauxite Company, and afterwards by Alcoa Minerals of Jamaica and Revere Jamaica Alumina Limited proved deposits in areas inhabited by small holders. The result is that since 1962, mining has been underway in villages and communities occupied by them. Further, many of these original holdings (some land settlements), have actually been further subdivided, so some may be less than one acre, and 20 owner/occupiers on one orebody is not uncommon. The true impact of this is only now being felt. Another factor is that many mineral deposits are being made uneconomic by developments on or near them and it is possible for the owner/occupiers to suffer financial loss or hardship if they hold out for higher prices and only decide to sell at the last minute.

It is difficult, if not impossible to live within or adjoining mining areas, because of the high dust and noise levels. It must be recognized that the uprooting and dislocation of the living patterns of people whose lives are dependent on rural agriculture tends to encourage migration to urban areas.

The present practice of leaving the small holder to negotiate alone with the mining companies should not be allowed to continue. The small holders, at present, have no legal rights to enjoy directly any of the benefits from the minerals present in their holdings. Further, if the companies choose to enforce their rights, under the Mining Law, Chapter 253, this puts a large wealthyforeign corporation, which is able to afford a battery of local luminaries, against small country farmers. Such a situation can lead to unfavourable inferences; this has only been done once.

In-action is neither in the best interest of the people, Government or the Mining companies. A specific example of Government's loss is in Orebody No. 95, located within Special Mining Lease No. 75. This orebody contains approximately 502,000 SWT of bauxite ore, 300,000 SWT of which was within lands owned by the company. This amount would, however, be reduced by approximately 32,000 SWT on parcels which they did not own, having regard to restrictions relating to unowned parcels pursuant to the Mining Law and Regulations made thereunder. This is in addition to an estimated 170,000 SWT of ore on 3.7 acres owned by small holders, making a total of 202,000 SWT of ore which is unavailable. The total revenue lost to Government because this ore was not mined was $472,064 at existing revenue. This situation cannot continue.

A solution is to phase the land acquisition into an agreed mining programme, in short, a national minerals development policy.

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Appendix

Some examples of areas of investigation for Restoration Research on bauxite-mined lands and associated marginal lands:

1. Depth of soil spread required for restoration to produce acceptable yields of crops.

2. Slope considerations in Land Reclamation.

3. Procedures necessary for securing the soil material to provide an agreed soil-depth-spread during reclamation.

4. Effects of stock-piling soil on soil productivity.

5. Determination of what implements are best suited for restoration on bauxite lands.

6. Physical and chemical properties and behaviour of bauxite soils.

7. Soil-crop moisture relations.

8. Soil fertility requirements of crops on restored bauxite-mined lands and also on associated marginal lands.

9. Crop rotations and combinations for restored lands.

10. Agronomic practices for agricultural pursuits on restored lands and associated marginal lands.

11. Introduction and testing of new crop species and varieties to include crop adaptability and productivity.

12. Forest tree adaptability and productivity. Introduction and testing of new forest trees.

13. Rearing of livestock on restored lands and associated marginal lands.

14. Suitability of reclaimed lands for building and town expansion.

15. Socio-economic aspects of restoration.

16. Amelioration of red mud for the growing of plants.

17. Alternate uses of red mud.