

The Evolution of Bauxite Mining in Jamaica – Modern Challenges for a Mature Industry

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Abstract

Bauxite mining began in Jamaica in the early 1950s. Bauxite was first exported by Reynolds Metal Company. Shortly after this, Kaiser and Alcan also set up mining operations and began exporting bauxite and alumina. After these first shipments, production increased rapidly, and within five years Jamaica had become the leading producer of bauxite in the world. In the over 60 years of bauxite mining, the industry has seen significant changes in how mining is conducted due to two main factors. Firstly, mining in Jamaica is always very close to population as the island is small and there are people settled in every area. This means that interaction between the mining companies and the local population is key to maintaining smooth operations, as the local residents do not hesitate to make their displeasure felt if there is a problem. Secondly, over the years the environmental lobby has become very strong and now has a significant impact on how and where mining will be allowed. In addition, global market conditions have driven mining companies to change their practices in order to reduce costs while still having to conform to fairly rigid mining and environmental laws. Thus, the industry has had to evolve to meet these challenges in order to survive.

Keywords: Jamaica, bauxite mining, mining in populated areas, Jamaica Bauxite Institute

1. The Early Days – The Big Four

Bauxite exploration and development work in Jamaica began during the 1940s and was carried out mainly by Alcan, Reynolds and Kaiser. These three North American companies came to the island to explore for bauxite, acquire reserve lands, and set up mining operations. On June 5, 1952 the first shipment of bauxite was made by Reynolds Jamaica Mines from its port in Ocho Rios to the parent company's alumina plant at Hurricane Creek, Arkansas. Kaiser followed a year later, shipping bauxite from Port Kaiser on the south coast. Alcan built the first alumina processing plant near its mines at Kirkvine, Manchester in 1952, and began shipping alumina initially from Kingston, and then in 1954, from Port Esquivel.

After that first shipment of bauxite in 1952, production increased rapidly, and by 1957 Jamaica had become the leading bauxite producer in the world, with a production capacity of nearly 5 million tonnes of bauxite per year, almost a quarter of all the bauxite mined in the world in that year.

The Jamaican bauxite was very fine-grained and did not behave like other bauxites elsewhere in the world. All three companies, Alcan, Reynolds and Kaiser, had to develop appropriate technology to economically refine Jamaican ore into alumina and were quite successful in processing the low monohydrate hematite ore.

With growing demand for alumina in the 1950s, Kirkvine Works production capacity was expanded in a series of construction programmes, from 220,000 tonnes per year in 1954 to 550 000 tonnes by 1968. Alcan built a second refinery at Ewarton, St. Catherine which began producing alumina in 1959. The plant's initial design capacity called for 250 000 tonnes of

alumina per year, with provision for further expansion in its design. The production of alumina increased and by 1968, Alcan had brought the capacity of its two refineries to 1.1 million tonnes a year.

In 1967, Kaiser commenced mining operations in St. Ann, with headquarters in Discovery Bay where they built a drying facility and a port, Port Rhoades, to ship bauxite. Then, in 1969 a new alumina refinery was commissioned at Nain, St. Elizabeth, by Alumina Partners of Jamaica (Alpart), a consortium of Kaiser, Reynolds and Anaconda. This refinery was the only one capable of processing high monohydrate bauxite, of which there was a significant amount in Jamaica.

A fourth mining company, Alcoa, started as a bauxite mining venture in 1959 and exported its first shipment of unprocessed bauxite from the Rocky Point port in Clarendon in 1963. The company began alumina production at a new refinery in Halse Hall, Clarendon in 1972 with a production capacity of 500 000 metric tonnes per year.

Revere Copper and Brass had opened an alumina plant at Maggotty, St. Elizabeth in 1971 but it didn't operate for very long, closing after four and a half years due to processing problems and financial constraints.

In 1971 Australia overtook Jamaica as the world's leading producer of bauxite. By 1974 Jamaica had become the world's second largest producer of bauxite and the second largest exporter of alumina. At the end of the 1970s, Guinea in West Africa also drew ahead of Jamaica, and was then followed by Brazil in the early 1980's and China and India in the first decade of this century.

During the 1970s, there were important changes in the ownership of the industry and in its contribution to the Jamaican economy. Although the mineral had been owned by the State since colonial times, the companies exploiting it were wholly-owned subsidiaries of North American-based aluminium companies. Government purchased 51 % of Kaiser and Reynolds, 6 % of Alcoa and 7 % of Alcan, and repurchased most of the ore reserve lands formerly owned by the companies. In return, the companies were granted forty-year mining leases. In 1974, following dramatic oil price rises, the Government increased bauxite taxes by the imposition of a Production Levy. The Government also set up new agencies to manage its enlarged interest in the industry. The principal of these, the Jamaica Bauxite Institute, began operating in 1976 to monitor, regulate, conduct research and advise the Government on all aspects of the industry.

In 1980, after lengthy negotiations, the Jamaican government acquired all the land owned by Reynolds, plus 50 % of the company's mining assets to create a partnership, with Reynolds continuing to manage the operation. Early in 1984 however, Reynolds announced their intention to pull out of Jamaica and by mid-1984 they were gone, an abrupt end to an important chapter of local history. To date the Jamaican government has been unable to find another joint venture partner or foreign investor to re-open those mines. The Reynolds pier in Ocho Rios is still used to ship sugar, high grade limestone and is more frequently used by cruise ships when there are more than two of these in port.

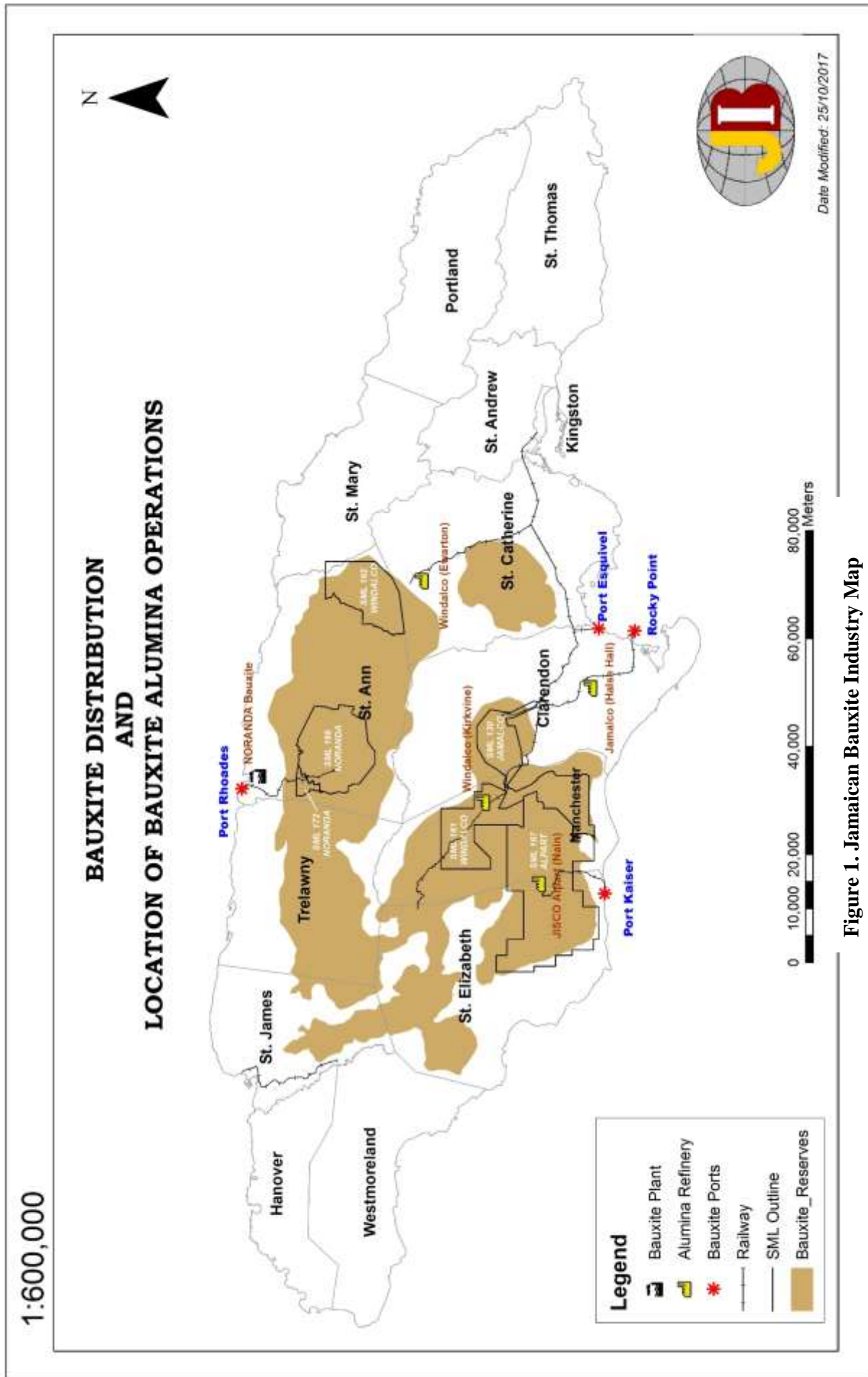


Figure 1. Jamaican Bauxite Industry Map

In 1988, the Government of Jamaica acquired a 50 percent share in Alcoa's Clarendon operations, forming a joint-venture between General Alumina Jamaica LLC (formerly known as Alcoa Minerals of Jamaica, LLC) and Clarendon Alumina Production Ltd (CAP). (a wholly owned Government company). The resulting company was named Jamalco, with Alcoa as the managing partner. Prior to this, Government participated in the joint venture under an October 1976 agreement when Alcoa as the majority shareholder owned 94 per cent of the interest and Jamaica Bauxite Mining Limited (a wholly owned Government company) owned the remaining 6 per cent. CAP was created in 1985 to manufacture and sell alumina at the leased Jamalco refinery, after Alcoa had shut down the operations in that year. With the re-entry of Alcoa in 1988, CAP became a joint-venture partner with an equal share in the plant.

The Jamalco refinery's capacity was upgraded to 1 million mtpy in 1999 and then to 1.25 million mtpy in 2003. The completion of a further upgrade in March 2007 lifted the production capacity of the refinery to 1.425 million metric tonnes per year. Following the 2007 expansion, Jamalco's ownership structure changed with Alcoa owning 55 per cent and the Government of Jamaica, 45 per cent.

Alumina Partners of Jamaica (Alpart) has its bauxite mining and alumina processing plant located at Nain, St. Elizabeth, in the south of Jamaica. The company was first established in the early 1960s under the union of three companies (Anaconda, Kaiser Aluminum and Reynolds Metals). It has subsequently undergone several partnership and ownership changes. The plant was closed in 1985, and reopened in 1988 under a joint-venture arrangement, with Kaiser holding 65 per cent of the equity and Hydro Aluminium, a major Norwegian company, owing 35 per cent.

2. The Changing of the Guard

Up until 2001 therefore, the original four players controlled the bauxite and alumina industry in Jamaica. The first major change of hands in this original group of players came in May 2001, when Glencore, an Anglo-Swiss multinational commodity trading and mining company, bought Jamalcan, Alcan's operations in Jamaica. This included the two alumina plants – Ewarton Works in St. Catherine and Kirkvine Works in Manchester, the bauxite mines in Schwallenburgh (Ewarton) and Russell Place (Kirkvine) and farms in Manchester and St Ann and Port Esquivel in St. Catherine. Jamalcan had been a joint venture with the Government of Jamaica, with Alcan owning 93 % and the GOJ owing the other 7 %. The new company was renamed the West Indies Alumina Company (Windalco). At this time, the combined capacities of Ewarton Works (670 000 tonnes) and Kirkvine Works (610 000 tonnes), gave Windalco a production capacity of at 1.28 million tonnes of alumina per year.

At the beginning of 2004, Alpart was still jointly owned by Kaiser Aluminum and Chemical Corporation (65 per cent) and Norsk Hydro ASA (35 per cent). Kaiser, however, was faced with serious financial problems and had to sell its 65 per cent stake in Alpart and its 49 per cent stake in Kaiser Jamaica Bauxite Company (KJBC) in St Ann. Under the existing Alpart partnership arrangement, Hydro had first-refusal rights to acquire the Kaiser share. Kaiser's interest was subsequently obtained by Glencore.

Also in 2004, Century Aluminum Co. and Noranda Finance Inc. acquired 50 % interest each in alumina refining and related bauxite mining assets from Kaiser Aluminum & Chemical Corporation. These assets included the alumina refinery in Gramercy, Louisiana and the bauxite producing facility in Discovery Bay, Jamaica. They formed the St. Ann Bauxite Company, purchasing Kaiser Aluminum Corporation's 49 per cent stake in Kaiser Jamaica Bauxite Limited (the other 51 per cent being owned by Government of Jamaica). The mining partnership

then supplied bauxite ore to the Gramercy facility and a third-party refinery, Sherwin Alumina in Texas.

Then, in April 2007, there was a merger between RUSAL, SUAL and the alumina assets of Glencore. This merger led to the formation of United Company RUSAL (UC RUSAL) and created the world's largest aluminium producer. This meant that UC RUSAL now owned all Glencore's stake in Alpart (65 per cent) and Winalco (93 per cent) and, at that time, controlled approximately a 52 per cent share in Jamaica's alumina production. Jamaican workers (staff, hourly paid and contractors) in the bauxite and alumina industry, government officials, unions, suppliers and other categories - long accustomed to the ground rules, management style, expectations and bonding relationships formed with North American companies - now found themselves trying to understand, work and come to terms with a completely foreign culture. The ownership arrangement at Alpart continued until 2011, when Hydro decided to offload its 35 per cent stake, and this was acquired by UC RUSAL, thus giving it complete ownership of the operation. As a consequence, UC RUSAL's ownership of the island's alumina production (100 per cent Alpart and 93 per cent Winalco) had risen to a whopping 65 per cent.

Then came the global economic downturn in 2008/9 which had a deep impact on the bauxite/alumina industry. Jamaica had by then fallen to sixth place in the world, and Jamaica's share of world bauxite output fell from 18.1 % in the 1970s to about 7.1 % of total world production of 205 million tonnes in 2008. Three out of the four bauxite refineries were closed – Alpart, Ewarton and Kirkvine, with only Jamalco remaining active throughout. As the market picked up a little, Ewarton Works came back on stream in mid-2010, but Kirkvine remains closed to this day.

In 2009, at the height of the financial crisis, Noranda took a 'leap of faith' to become sole owners of the mining lease and assets from St Ann Bauxite Limited, giving them 49 per cent stake in Noranda Jamaica Bauxite Partners Limited. Like Jamalco, they too were able to remain operational throughout the period of global uncertainty. Major expansion work in 2011 resulted in a production capacity boost from 4.5 million tonnes of bauxite per annum to a possible 5.2 million tonnes per annum.

By 2012, over one-half of the country's alumina capacity was still closed, and with output hovering around the 10 million tonne per annum mark, Jamaica's position in the world industry experienced further slippage.

Jamalco was the only alumina refinery that was able to remain open during the global financial crisis by employing severe cost cutting measures. In October of 2014, Alcoa announced that it was selling its 55 per cent interest in the Jamalco refinery to global commodities company Noble Group Limited. As a result, the Clarendon Alumina Works refinery and related mining and port operations, which continue to be carried out under the name "Jamalco", is owned 55 % by General Alumina Jamaica LLC (GAJ) and 45 % by Clarendon Alumina Production Ltd (CAP). Alcoa World Alumina and Chemicals (AWAC), whose joint venture interest was held through Alcoa Minerals of Jamaica, was paid to manage the plant for another three years under a service agreement.

3. Latest Developments

Noranda Aluminum was hit by a financial crisis hit in 2016, and the US Bankruptcy Courts subsequently gave an order approving the sale of certain assets of Noranda Aluminum, Inc. The assets included the aluminum refinery located in Gramercy, Louisiana and bauxite mining assets and interests located in Jamaica. This impacted their third party customer, Sherwin Alumina Co, a subsidiary of Glencore, who then announced that it would be closing its plant in Gregory,

Texas, resulting from the bankruptcy court's releasing of Noranda Bauxite Ltd from its supply contract with Sherwin. Shock waves were immediately felt back at the Jamaican operations where for the first time since the recession, only one ship per week (compared to three) called at Port Rhoades as shipments fell by almost 50 per cent.

At this point, Noranda Bauxite came very close to closing its operations in Jamaica. At similar risk was the Noranda Alumina refinery in Gramercy, Louisiana, USA, consumer of half of the mine's production capacity. Then, New Day Aluminum, an affiliate of DADA Holdings, purchased Noranda's 49 per cent share of the bauxite operations in St Ann and the Gramercy alumina operations in late 2016, avoiding the closure of the facilities and initiating a new path forward in a public-private partnership with the Jamaican government.

In November 2016, UC RUSAL announced that it had completed the sale of a 100 % stake in Alpart to the Chinese state industrial group, Jiuquan Iron & Steel (Group) Co. Ltd. (JISCO). The Alpart refinery had been closed by UC Rusal in 2009 in the wake of the Global Financial Crisis. However, in June 2017 the refinery was reopened by JISCO, and in December 2017, 35 000 tons of alumina was shipped from Port Kaiser, the first shipment in nine years. Alpart, the largest refinery in Jamaica, has a capacity of 1.65 million tonnes.

Since then, JISCO has indicated to the Government of Jamaica its intentions to invest more than US\$3 billion to develop the Gansu-Jamaica Industrial Park and Special Economic Zone in Nain, St Elizabeth, where it operates the alumina refinery. The park is to have a phased development which will involve the establishment of a new bauxite/alumina refinery and an electricity plant to power it, and will focus on manufacturing aluminium products locally. In addition to alumina and aluminum processing, other industries will include limestone processing, machinery, as well as agricultural and aquatic product processing. It is intended to move Jamaica from exporting raw materials to developing value added manufacturing and fabrication industries, led by the bauxite/limestone sector.

4. Meeting the Challenges of a Mature Industry

Based on all these developments, it is clear that the bauxite/alumina industry in Jamaica has undergone significant changes over the years in terms of the ownership of the companies and their relationship with the Government and people of Jamaica. They all face similar challenges with respect to mining, processing and co-existing with the population. While they have each found individual solutions to these problems, depending on their company culture and that of their neighbors, the Jamaica Bauxite Institute has been there to facilitate their progress and to take a 'big picture' approach to implement best practices for the industry as a whole.

The Jamaica Bauxite Institute (JBI) is a repository of information on bauxite and alumina with a solid reputation for research and analysis of data and trends in the industry. The existence of the JBI puts Jamaica in the position of being one of the few developing economies with an institution devoted solely to the research and development of one of its prime mineral resources. For over 40 years, the JBI has been committed to the sustainable development of the bauxite/alumina industry while ensuring the management of the environment for the greatest benefit of the Jamaican people. The Institute works in collaboration with other agencies and is pro-active in attaining compatibility between the Industry's operations and the environment by ensuring that operations are conducted with minimal impact on the environment. The JBI ensures compliance with local environmental standards and regulations, and conducts regular reviews of environmental performance. The JBI also promotes research and development aimed at identifying new technologies for a cleaner, more efficient production process and waste minimization.

One of the key roles of the JBI is to monitor bauxite production and allocate reserves for mining based on the needs of each company's refinery. The JBI conducts exploration programmes in an effort to expand the database of knowledge about Jamaica's bauxites. This includes surveying/mapping of deposits, drilling and collection of samples, chemical analyses, and the production of maps and reports pertaining to the particular area. The broad objective is to characterize the nature of Jamaican bauxite, which is unique in many ways, and to facilitate the continued development of the industry.

In an attempt to ensure harmonious relationships with communities in the vicinity of bauxite/alumina operations, the JBI has to assess the impact of mining activities on these communities and respond to complaints made by persons in mining communities and help to resolve conflicts. The JBI has been working, too, at maintaining a harmonious industrial relations climate in the bauxite/alumina industry, as continued investor confidence relies heavily on amicable relations between the industry's management and employees. From time to time, the JBI also has to conduct negotiations with the owners and operators of the mining enterprises on behalf of the Jamaican Government, to ensure that the country's interests are protected.

Unlike most countries where bauxite mining occurs, mining in Jamaica is always in proximity to population. Mining companies have had to devise strategies to co-exist with the local people. We Jamaicans are a very forthright people, and they will not sit quietly by and allow infringement of their rights. They are very vocal and will not hesitate to protest, block roads and shut down active mining areas if they feel they are being dealt with unfairly. Public relations are of utmost importance for smooth operations in the industry

All the mining companies are holders of large acreages of land. Most of the land belongs to the Government but is managed by the holder of the mining lease. The objective of this approach is to prevent sterilization or squatter encroachment. The vast majority of the land is under pasture, which in the early days, led some companies to get involved in the cattle business, notably Alcan and Reynolds. In its heyday, Reynolds' cattle herd exceeded 15 000 head and they had an affiliate company doing cold storage and meat processing. Alcan's Rio Hoe/Unity Valley dairy and Content beef cattle farms are still maintained by Windalco to the present time. All the companies have tenant farmers on their land, and where the land is unmined, the farmers would be given ample notice to reap their crops before mining commences. After mining, the land would be restored and returned to the farmers or left as pasture.

Jamaica is almost unique in world mining history in that, from the inception, emphasis has been placed on the rehabilitation of the mined-out bauxite lands. The island is too small and too populated for us to allow that any land should be laid waste by bauxite mining. The Jamaica Bauxite Institute works closely with the Office of the Commissioner of Mines in ensuring that land disturbed for bauxite mining is satisfactorily restored and certified. The ultimate responsibility for bauxite land reclamation rests with the Commissioner of Mines, in accordance with the country's Mining Act. As part of its mandate, the JBI manages the use of bauxite land in both the pre-mining and post-mining stage and together with the Commissioner of Mines, ensures that pre-mining, mining and post-mining activities take place in sync with consistent environmental management practices.

Again, possibly unique to Jamaica as a developing economy, there is a fairly robust set of mining laws which are strongly enforced. The Mining Regulations were amended in 2004 to encourage timely restoration of mined out bauxite lands. The changes included the introduction of a time frame by which reclamation activities must be completed and an increase in penalty fees. It is now required that orebodies are rehabilitated within 3 years of being certified mined out and permission granted for rehabilitation to start by the Commissioner of Mines. Failure to meet this requirement incurs a penalty of US\$ 25 000 per hectare of land which is charged to the

company and an additional US\$ 2 500 per hectare for each year that it remains uncertified. Generally, all the bauxite companies now do a very good job of meeting the restoration standards within the allotted time frame, although in the past, pits were sometimes left unreclaimed for long periods, giving the industry a bad name which has been hard to shake.

The JBI's objectives regarding reclamation and the use of mined out lands include:

- Reducing the backlog of unreclaimed lands
- Effectively increasing the area of mined out lands under commercial agriculture
- Making more lands accessible to more small farmers
- Making mined out lands available to meet the demand for housing and other non-agricultural uses.
- Minimizing the aesthetically unpleasant appearance of unreclaimed lands.

This programme of compulsory rehabilitation has been singularly successful, in spite of the many problems involved. Each company has developed operational systems which work best for them, but there is some amount of shared expertise via the National Restoration Committee on which they all sit. Reclamation methods have also evolved with time, and we are proud to say that in some of the more recently reclaimed areas, it is difficult to identify which pits have actually been mined and which have not. The bauxite mining areas are often very rugged, occurring as they do atop karst limestone, so reclamation is actually quite an expensive undertaking, but reclaim they must.

With respect to post mining land use, lands are generally returned to pasture. A significant acreage has also gone back into farming of cash crops, orchard crops, and forest trees. In areas where farmland is desired by residents, the land will be put into crops and then handed over to farmers with the mining companies continuing to provide some level of support. If the mining area is near to a town where land is required for expansion, then the mining company will work with local authorities to decide on the best end use. These may include lands for resettlement of residents dislocated by mining or new residential developments, school playgrounds, community centers, landfills, water harvesting areas, orchards or forest.

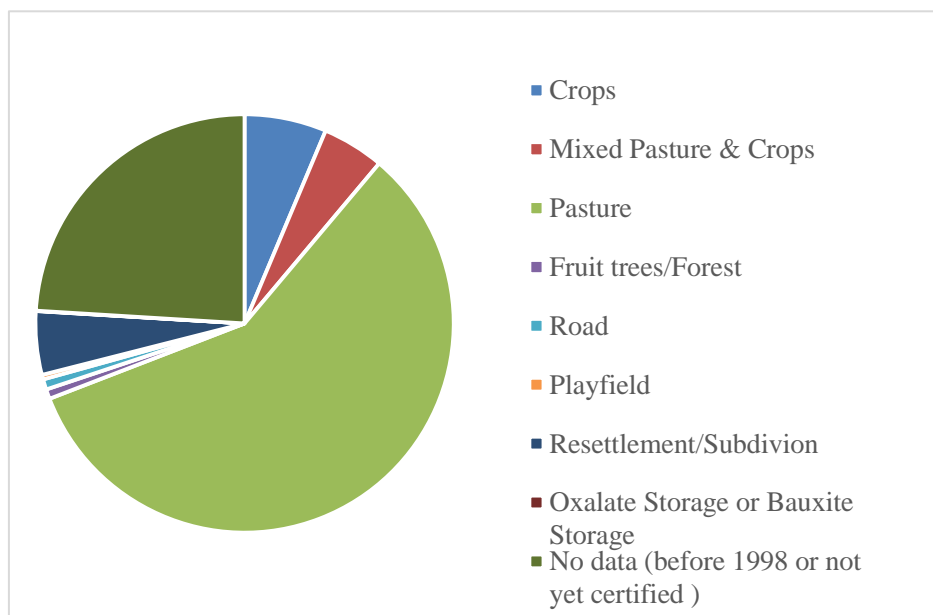


Figure 2. Post Reclamation Land Use

5. Bauxite Community Development Programme

Our biggest success story at the JBI, and one of which we are very proud, is the implementation of the Bauxite Community Development Programme (BCDP). This programme set up special funding for communities near bauxite and alumina operations which face a number of challenges including the effects of noise, dust, plant odors, spillages, a reduction in access to agricultural lands, the dereliction of mined-out lands and relatively low levels of infrastructural development and employment. The programme was established in October 1996 by the Government of Jamaica which designated the Jamaica Bauxite Institute (JBI) the agency responsible for its management.

The main goal of the programme is to reinvest earnings from the bauxite/alumina industry by implementing long-term sustainable projects in communities affected by bauxite mining and alumina operations. Ultimately, the programme is expected to lead to improvements in standards of living in the affected communities and to ensure that there is “Life after Bauxite”. Since the beginning of Phase I of the BCDP programme in 1996, to the end of Phase VI in 2016, approximately J\$450 million was disbursed for over 280 projects in the areas of agriculture, adult learning, vocational skills training, the refurbishment and construction of classrooms and computer laboratories in schools and adult training centers, the refurbishing of community facilities and repairs to numerous sections of roadways in the five bauxite parishes. The BCDP also funded a major water supply project in St. Elizabeth and electricity extension programme in Manchester by the Rural Electrification Programme Ltd.

The programme has been made more effective through the establishment of seventeen (17) Joint Bauxite Community Councils within the bauxite mining, port, rail and alumina plant communities. The monthly joint bauxite council meetings provide the forum for identifying and developing ideas and proposals for the BCDP and is also a forum for open communication, critical dialogue and the resolution of issues between affected communities, bauxite companies, government agencies and other stakeholders. Residents therefore have the opportunity to express concerns and these are dealt with promptly before the situation escalates. The councils aim to reinforce the economic and social relevance of the industry, while recognizing and addressing the priorities of the communities.

BCDP projects are reflective of the needs of the communities in which they are located. The identification and successful implementation of projects in mining communities is heavily dependent on the involvement of community members. All project ideas and proposals are developed at the level of the Joint Community Councils or they are implemented on the recommendation of the Member of Parliament after vetting by the Community Council. Projects are selected on the basis of their viability, the extent to which they will be effective in improving the quality of life of the affected communities, and their compatibility with the socio-economic environment in which they are being implemented.

During Phase V, the BCDP actively set out to provide access to training for a number of youths in bauxite/alumina communities. The BCDP recognized the need to raise the educational and skill levels in these communities and has provided skills training and adult literacy opportunities aimed at making the youths in these communities more competent and better equipped for the workforce. Several schools and community centers have also received funding in an effort to support the development and maintenance of educational and community facilities and amenities.

A more recent development during Phase VI has been a collaboration between the Jamaica Bauxite Institute (JBI) and Jamaica Social Investment Fund (JSIF) on the implementation of

several Water Catchment and Greenhouse Cluster Projects in the parishes of St. Ann, Manchester and St. Elizabeth. A critical aspect of this project is the BCDP's facilitating and funding the establishment of water storage facilities through the conversion of mined out bauxite pits to catchment ponds for providing irrigation water for greenhouse and open field farming.

This project arose out of the need to address a major problem faced by farmers in bauxite mining areas, i.e., the lack of access to land for farming and the absence of a reliable supply of irrigation water. The conversion of mined-out pits to water catchment ponds and the increased access to lands around these ponds, has helped farmers in bauxite areas to significantly increase their production and incomes. The importance of agriculture to rural communities is well known, as are the important linkages that the farm economy has with other sectors of the rural economy. This project has demonstrated that the use of appropriate rain water harvesting technologies can be used as a model for drought affected areas.

The first of the JBI/JSIF water harvesting and greenhouse clusters was launched in February 2014 at Tobolski, in the Noranda mining lease area. Eventually, a total of 20 greenhouses were constructed in each of the eight targeted communities, with a mined-out pit at each site being converted into a surface water reservoir to be used for irrigation purposes. A total of one hundred and sixty (160) farmers from eight communities in St. Ann and Manchester benefitted from this project initially, but more importantly, these farmers are able to pass on their knowledge of how to construct and maintain these greenhouses to others in their communities. In fact, we have had farmers who were involved from the outset going into other mining areas and assisting with construction of greenhouses on the newer projects. The farmers quickly discovered that by controlling the growing environment, they were able to produce crops of superior quality. For these farmers, local agriculture has been transformed, with farmers reporting a 500 % increase in harvests and crops are no longer affected by droughts and other problems. They are also assisted with marketing, and are currently supplying a number of hotels in the tourism sector with fresh produce. The success of the programme has earned international attention with requests being made for the sharing of experience.

The bauxite companies have indicated their continued support for the project and have committed to assist with the site preparation for the development of the ponds and the leasing of lands to farmer groups to facilitate the project. In general, the project is geared at placing formerly small scale subsistence farmers on mined-out bauxite lands, and providing the necessary infrastructure and equipment for them to do greenhouse farming on a larger scale. More recently, work has also started in research and development to further the use of mined out lands to grow plants with medicinal value for the pharmaceutical industry, including marijuana.

In 2004, the JBI received a grant of J\$1.7 million from the G. Raymond Chang Foundation to establish a Plant Nursery to provide support to BCDP funded agricultural projects. The facility is located at the JBI in Hope Gardens and has the capacity to produce an average of 1.2 million seedlings annually. The Nursery specializes in the production of high quality vegetable and herb seedlings and an assortment of fruit tree plants. Since commencing operations in 2005 it has produced seedlings for many BCDP projects. e.g. Walkerswood Agricultural Project, supplying farmers in the Walkerswood area with Scotch Bonnet Pepper seedlings to produce peppers for the processing plant. Since 2016 the Nursery has been providing seedlings for the JBI /JSIF Water Harvesting and Greenhouse Cluster Project.



Figure 3. Greenhouse farming in Watt Town, St. Ann Jamaica

Apart from all these initiatives mentioned, each bauxite company has its own projects with respect to corporate social responsibility. These include the setting up of micro-enterprise business development programs, providing a supply of potable water in areas where the National Water Commission service is inadequate, and scholarships at secondary and tertiary education levels.

6. Contract Mining

Another development which has had a major impact on the mining industry but has never really been acknowledged as such is the advent of contract mining. In 2001, a joint venture partnership, the Alpart Mining Venture, was formed between Alpart and Jamalco. This entity was responsible for supplying bauxite to both refineries. The mining contractor selected was the Henry Walker Eltin Group Limited (HWE) and they brought in heavy equipment for large scale mining. However, by 2002/3, Jamalco came to realize that the big mining solutions did not work well in Jamaica. The partnership eventually dissolved at the end of 2004 and Jamalco went to small mining solutions using local contractors. Alcoa was hesitant to approve this plan at first, but Jamalco were able to convince them that it could work. The mining contractor put together a team of local subcontractors, truckers each using their own trucks, but they had to abide by Jamalco's rules for operational procedures, especially with respect to health and safety because any liability would ultimately be the responsibility of Jamalco. This plan worked very well for Jamalco, but Alpart continued with the large mining solutions, now being carried out by Washington Group who had since acquired HWE, until Alpart's closure in 2008.

Washington Group had also been mining for UC Rusal's Windalco operations but at the restart of the Ewarton plant in 2011, it was decided to send most of the big equipment to Guyana, for which it was much more suited, and go with local haulage contractors for mining and reclamation. Noranda followed suit in 2012 and today all bauxite mining in Jamaica is carried out by local contractors using their own trucks. This has been very beneficial to the trucking industry and the mining communities in general, and has resulted in a significant upgrade in the truck stock in the sector as truckers were able to gradually replace their old trucks with newer, more reliable models. This has been a real win-win situation for the mining companies, the haulage contractors and the truckers alike.

7. Environmental Lobby

A significant challenge to the bauxite industry in Jamaica going forward is the increasing strength of the environmental lobby. Even within the government service, there are stakeholders

who are very opposed to mining in any form and are unyielding in their opposition regardless of the fact that mineral resources must be exploited for national development. Mineral extraction in all forms has been banned in designated protected areas and all forest reserves. This decision has recently protected over 74 726 hectares, known as the Cockpit Country Protected Area, inclusive of hydrological and ecological features and cultural and heritage sites. The areas protected under forest reserves have also been expanded. The decision to forego the exploitation of these areas will cost the country millions of tonnes of high-grade bauxite and limestone with potential earnings of billions of US dollars.

Overall, the bauxite industry has had a positive impact on the development of Jamaica as a whole and especially, towns or villages surrounding their operations, such as Mandeville, Manchester; Santa Cruz and Junction St Elizabeth; Brown's Town, St Ann; May Pen, Clarendon and Ewarton, St Catherine. Mined-out lands have been earmarked for uses such as housing development in the expansion of these towns, for community playing fields and recreational facilities, haul roads have been converted to major roads such as the Winston Jones Highway and the Melrose bypass in Manchester and so on. Mined out pits have been used for municipal garbage disposal sites or for domestic water-storage purposes with the use of impermeable linings. The Wigton wind-turbine complex near Newport, Manchester and BMR complex in the Malvern area of St. Elizabeth are both located on bauxite lands, and are now supplying over 100 megawatts of power to the national grid, almost 10 % of our energy requirements. By facilitating these activities on mined out lands, the bauxite industry is indirectly contributing to national development.

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