Editorial

Potential Health Impacts of Bauxite Mining in Kuantan

Noor Hisham Abdullah[1], Norlen Mohamed[2], Lokman Hakim Sulaiman[3], Thahirahtul Asma Zakaria[2], Daud Abdul Rahim[2]

Submitted: 25 Feb 2016
Accepted: 28 Feb 2016

[1] *Office of Director General of Health, Level 12, E7, Ministry of Health, 62590 Putrajaya, Malaysia*

[2] *Environmental Health Unit, Level 2, E3, Disease Control Division, Ministry of Health, 62590 Putrajaya, Malaysia*

[3] *Office of Deputy Director General of Health (Public Health), Level 12, E7, Ministry of Health, 62590 Putrajaya, Malaysia*

Abstract

Bauxite mining is not known to most Malaysian except recently due to environmental pollution issues in Kuantan, Pahang. Potential impacts are expected to go beyond physical environment and physical illness if the situation is not controlled. Loss of economic potentials, and the presence of unpleasant red dust causing mental distress, anger and community outrage. More studies are needed to associate it with chronic physical illness. While evidences are vital for action, merely waiting for a disease to occur is a sign of failure in prevention. All responsible agencies should focus on a wider aspect of health determinants rather than merely on the occurrence of diseases to act and the need to emphasize on sustainable mining to ensure health of people is not compromised.

Keywords: *health impact, bauxite, mining, environmental pollution, disease, Malaysia*

Introduction

Bauxite mining in Kuantan offers some exciting economic opportunities for various parties including individual land owners. Nevertheless, the "bauxite boom"; the extensive and uncontrolled mining activities have great potentials to cause adverse impacts on the environment, health and quality of life of the people living in the affected areas.

Bauxite mining is not a new economic activity for Malaysia. The mining of bauxite has taken place in the state of Johor since early 2000 (1). Whilst bauxite mining operation in Teluk Ramunia Johor has been operating for more than 15 years without much controversy, bauxite mining in Kuantan has created a different scenario within a short period of time. Extensive and aggressive mining which include transporting and stockpiling of bauxite in huge quantities cause environmental problems to emerge within a short period of time leading to community outrage.

Potential Impacts on Health

The health of people and the health of the planet that we live in are inextricably linked. Destruction of our habitat threatens our access to the most fundamental requisites for human existence: safe water, clean air, safe food and shelter. Aggressive uncontrolled bauxite mining in Kuantan, if sustained over time will cause irreversible changes to the state of the environment that threatens the ecosystems. Because of environmental pollution issues, the Ministry of Natural Resources and Environment has imposed a three-month suspension on the industry starting from 15 January 2016. The polluted ecosystems have great potential to create chronic and unpredictable exposures, leading to direct or indirect, immediate and long-term potential impacts on health. A number of physical, chemical, biological, ergonomic, and psychosocial hazards exist throughout the mining process, as

described in the article by Donoghue and Olney (2). Based on our observation, the potential impacts on health can be direct and indirect and the potential linkages between mining activities and health are as shown in Figure 1.

There are a number of reasons why bauxite mining in Kuantan can cause environmental problem which will subsequently propagate to impact on health if the issue is not resolved or controlled. One of the reasons is related to its location which is close to the human settlement area. Other reason is associated with unsustainable mining processes that lead to very extensive and aggressive mining activities.

Mining impact zone

The location of mining activities in relation to human settlement is of great concern to public health. While remote locations and well defined zoning area are common in bauxite mining in other countries (2), it is a totally different scenario in Kuantan. The mining area is scattered and occurring near to and within community settlements without a clearly defined zone. It is also close to school areas whereby most of the vulnerable children spend their time (Figures 2 and 3). It is very difficult to estimate the total area involved as the mining activities are operated by both legal and illegal individual miners. The number of illegal individual miner is said to be much bigger than legal miners making the control of the area and mining operations very difficult.

Air, food and visual pollution due to dust

Air pollution is one of the main issues faced by the community. Open mining involves substantial clearing and removal of land. The processes of excavating, removal of top soil and vegetation, transportation of bauxite and unwanted elements and stockpiling of bauxite cause degradation of air quality mainly related to dust pollution. Dust is a solid particulate matter, in the size range of 1 to 75 microns in diameter. Dust smaller than 10 micrometer in diameter, known as particulate matter PM10 and PM2.5 are of great health concern because it can be inhaled deep into the respiratory system. Data collected by researcher in December 2015, revealed that 24-hour PM10 level ($\mu g/m^3$) ranged from 164 to 277$\mu g/m^3$ which exceeded the Malaysian National Ambient Air Quality Standard 2015 (3).

Larger particulate matters are associated with nuisance. Nuisance dust reduces environmental amenity, contaminates clothes, properties, vegetation and water, and has negative effects on personal comfort and health. This situation is often the case with bauxite as it is obviously visible due to its high content of iron oxide. From our observation, the whole stretch of road along the Kuantan – Kuantan Port is tainted dark red. The tree, vehicles, houses, clothes and food premises along the route of the lorries transporting bauxite were also contaminated with red dust (Figures 4 and 5).

Nuisance dust particles are too large to be inhaled. Apart from causing visual pollution, it has the potential to cause irritation to the eyes, nose and throat. It also produces visual impact that can lead to mental health stress especially to those living in proximity to mining sites, particularly when it can be seen from their home (4). Furthermore, dust deposited on premises has the potential to contaminate food sources and clothes.

Fine particles are well documented to cause or trigger the occurrence of respiratory and cardiovascular diseases (5). The WHO advises that there is 'no safe level' of fine particulate air pollution, PM_{10} and $PM_{2.5}$. Both PM_{10} and $PM_{2.5}$ are respirable particles which can penetrate deep into the respiratory system and are associated with increased hospital admissions for heart and lung diseases and premature death (6, 7). It is of great health concern when mining activity occur in proximity to school area as children is among the most susceptible subpopulations with regards to harmful effects of exposure to particulate matter, PM10 (8, 9). As their physiological and immunological systems are still developing, children receive a higher dose of airborne particles relative to the lung size compared to adult (10, 11). Surveillance data gathered from the Bukit Goh Health Clinic, located within the area of mining operation has shown a steadily increased in patient attendance for asthmatic and upper respiratory tract infection (URTI) for 2015 as compared to previous year. However, work is still in progress to associate the increase in patient's attendance to the mining activities.

Water pollution and risk of mud flood

Water pollution was widely reported by mainstream and social media. The sources of water pollution are mainly related to extensive land clearing, extraction of bauxite leading to soil erosion and sedimentation; washing of bauxite and effluent from the bauxite washing pond

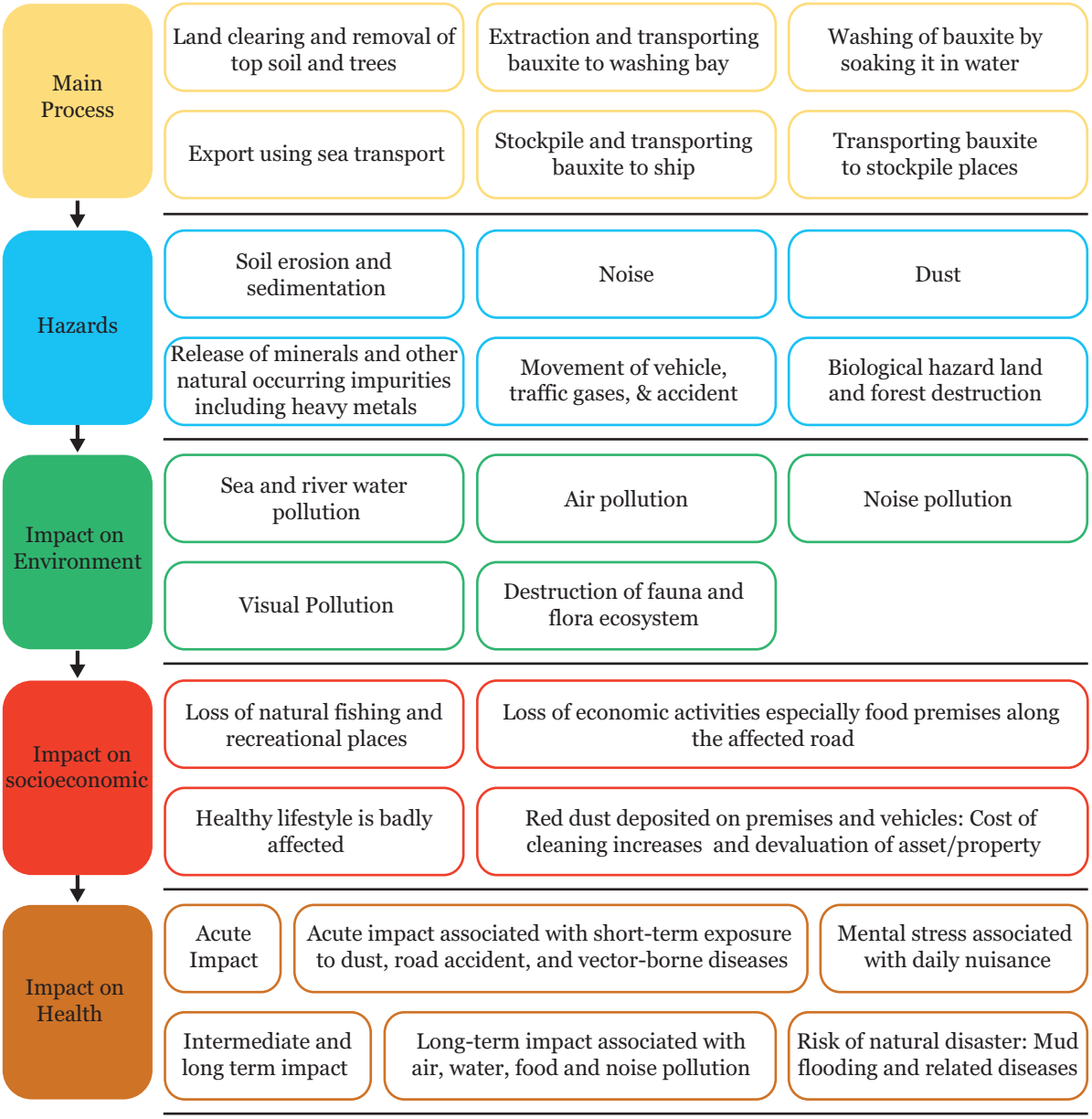

Figure 1: Linkages between bauxite mining activities and potentials impacts

which flows into the nearby river; and stockpile of bauxite in large quantities without a proper drainage system. Beside river and sea water pollution, an uncontrolled mining activity can also cause severe mud flood due to soil erosion and surface run off of cleared land. Fortunately, the recent monsoon was not accompanied by the usually heavy rain due to the effects of El Nino which lessen the monsoon effects.

Potential to contaminate drinking water

There are four water treatment plants located in the area of bauxite mining which are Bukit Goh, Bukit Sagu, Bukit Ubi, and Semambu Water Treatment Plant in Kuantan. As they are located downstream, the mining activities have great potentials to contaminate the drinking water sources. Bukit Goh Water Treatment Plant was closed once on 29 December 2015 due to severe pollution of Sungai Riau. Figures 6 and 7 shows a bauxite washing pond whereby the effluent

Figure 2: Mining activities occurring close to school area

Figure 3: Dust deposited on floor of the school

Figure 4: Red dust deposited on window of quarter next to Kuantan Port

Figure 5: Road stretch toward Kuantan Port heavily covered by dark red dust

Figure 6: Bauxite washing pond showing "red water"

Figure 7: Water from the pond were discharged into Sungai Taweh and Sungai Riau

water were discharged into Sungai Taweh which flows downstream causing severe pollution to Sungai Riau. Generally, bauxite contains mainly Aluminum oxide (40–50%), ferric oxide (20%) and 3–5% combined silica (12). However, according to Rajah, bauxite in Kuantan is characterised by high ferric oxide content ranging from 14.4 to 40.6% depending on the area (13). Because of its composition, aluminum and iron are the main contaminants that pollute the water resources but depending on the geological characteristics of the land and surrounding land use activities, other toxic metals such as arsenic, mercury, cadmium, lead, nickel and manganese may also contaminate drinking water resources when the natural ecosystem is aggressively removed and excavated. Chronic exposure to toxic metals may cause multiple organ toxicity and increase cancer risk. Whereas, high level exposure to aluminum in the stomach prevent the absorption of phosphate, a chemical compound required for healthy bones and may cause bone diseases in children (14). Chronic exposure to aluminum was hypothesised to cause Alzheimer disease but scientific evidence to date is inconsistent (15).

Based on a continuous drinking water monitoring conducted by the Department of Pahang State Health, so far the concentration of aluminum in treated water taken from the affected water treatment plants were below the Provisional Tolerable Weekly Intake (PWTI) of 0.9mg/l (16). The concentration of other heavy metals were also below the National Drinking Water Quality Standard. Apparently the conventional treatment method used in these water treatment plants is capable of managing the treat of heavy metals contaminations.

Noise pollution

Noise is an important consideration in the context of mining, and a factor that can potentially have serious health impacts across a wide range of determinants. Noise pollution usually occurs in three phases: access to the bauxite mining area, extraction of bauxite using heavy machinery and movement of lorries from mining area to stockpile places. Some of the mining activities are located very close to and within community settlement which make environmental pollution a real concern to the community. If the problem persists, environmental noise has a great impact on the health of the people. The potential health effects identified include hearing loss or loss of hearing sensitivity, sleep disturbance, cardiovascular and physiological effects, mental health and behavioural effects, cognitive performance including poor performance by school children (11, 17).

Public Health Surveillance System

Acknowledging the potential impacts on health, Pahang State Health Department has established a surveillance system to monitor continuously food and drinking water quality and diseases in the area of Kuantan. The surveillance system is known as Kuantan Environmental-Public Health Tracking System (KEPTS). The elements of KEPTS include a continuous monitoring of air pollution related diseases, road traffic injury, treated water quality and monitoring of raw food and ready to eat food sold within the bauxite mining areas. In addition to that, a mental health survey was also added into KEPTS. While the manual data collection has already taken place, the KEPTS is in the process of developing automated data system that supports and enable linking all data collected including environmental data from various authorities for the purpose of future follow up and analysis.

Conclusion

Uncontrolled bauxite mining operation in Kuantan has caused severe environmental pollution. Destruction of ecosystem threatens our access to the most fundamental requisites for human existence: safe water, clean air, safe food and shelter. The impact may persist if there is no proper rehabilitation plan done to the exploited area. While mental distress due to unpleasant living environment become apparent, more studies are needed to quantify the impact on chronic physical illness. Even though chronic physical illness are not apparent now due to it slow pathogenesis, the diseases may appear many years later if the current risk is not properly addressed and controlled. All responsible agencies should focus on a wider aspect of health determinants rather than waiting for the occurrence of diseases to before acting. It is important to emphasise on sustainable mining practices in order to avoid compromising the health of people in the future.

Acknowledgements

We would like to express our deep appreciation to Dr Nur Aiza Zakaria and her officers from Pahang State Health Department for assisting us in taking photos related to the bauxite mining activities in Kuantan and also for sharing information on Kuantan Environmental-Public Health Tracking System.

Correspondence

Dr Norlen bin Mohamed
MD, MPH
Environmental Health Unit,
Level 2, E3, Disease Control Division,
Ministry of Health,
62590 Putrajaya, Malaysia.
Tel: +603-8892 4421
Fax: +603-8892 4548
E-mail: norlen.mohamed@moh.gov.my

References

1. Minerals and Geoscience Department Malaysia. *Malaysian Minerals Yearbook 2010*. Kuala Lumpur: Minerals and Geoscience Department Malaysia; 2010. Available from: http://www.jmg.gov.my/component/rsfiles/download-file/files?path=penerbitan%2FMalaysian+Minerals+Yearbook%2Fmmy_2010.pdf.

2. Donoghue AM, Frisch N, Olney D. Bauxite mining and alumina refining: Process description and occupation health risk. *JOEM*. 2014;**56(5 Suppl.)**: 12–17.

3. Jamal Hisham Hashim (2016). *Public health impacts from bauxite mining activities in Kuantan*. Bauxite Forum, 16 February 2016, Kuala Lumpur.

4. Chadderton C, Elliott E, Williams G. *A guide to assessing the health and wellbeing impacts of opencast mining*. Wales: Wales HIA Support Unit (WHIASU); 2011.

5. World Health Organization (WHO). *Health aspects of air pollution: Results from the WHO project "systematic review of health aspects of air pollution in Europe"*. Copenhagen: WHO; 2004.

6. Pope CA, Burnett RT, Thun MJ, Callee EE, Krewski D, Ito K, et al. Lung cancer, cardiopulmonary mortality and long term exposure to fine particulate air pollution. *JAMA*. 2002;**287**:1132–1141.

7. Pope CA 3rd, Hansen ML, Long RW, Nielsen KR, Eatough NL, Wilson WE, et al. Ambient particulate air pollution, heart rate and blood markers of inflammation in a panel of elderly subjects. *Environ Health Perspect*. 2004;**112(3)**:339–345.

8. Annesi-Maesano I, Baiz N, Banerjee S, Rudnai P, Rive S. Indoor air quality and sources in schools and related health effects. *J. Toxicol Environ. Health B*. 2013;**16**:491–550.

9. Schuepp K, Sly PD. The developing respiratory tract and its specific needs in regard to ultrafine particulate matter exposure. *Pediatr. Respir. Rev*. 2012;**13**:95–99.

10. Foos B, Marty, M, Schwartz J, Bennett W, Moya J, Jarabek AM. Focusing on children's inhalation dosimetry and health effects for risk assessment: an introduction. *J Toxicol Environ Health*. 2008, **71**:149–165.

11. Health Evidence Bulletins. *Health evidence bulletins Wales: Healthy environments*. Cardiff: Welsh Office; 1999.

12. Valeton, I. *Bauxites*. Amsterdam: Elsevier Publishing House; 1972.

13. Rajah SS. Bauxite in the Kuantan area, Peninsular Malaysia. *GEOSEA V Proceedings Vol. I, Bulletin of the Geological Society of Malaysia*. 1986;**19**:315-325.

14. Agency for Toxic Substances and Disease Registry (ATDSR). *Public health statement: Aluminium*. CAS #7429-90-5. Atlanta: ATDSR; 2008.

15. Theodore I. Is the aluminum hypothesis dead? (Review). *JOEM*. 2014:**5(5 Supp.)**:73–79.

16. World Health Organization (WHO). *Guideline for drinking-water quality,* 4th ed. Malta: Guterberg; 2011.

17. Stansfield SA, Matheson MP. Noise pollution: non -auditory effects on health (Review). *British Medical Bulletin*. 2003;**68**:243–257.