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The Environmental Impact on Human Wellbeing: A Case Study on Residences in Quarry Area

Emma Marinie Ahmad Zawawi[1*], Wan Hasmirah Wan Ibrahim[1]

[1]Faculty of Architecture, Planning and Surveying,
Universiti Teknologi MARA (UiTM), Shah Alam, 40450, Selangor, MALAYSIA

*Corresponding Author

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Abstract: An Environmental Impact Assessment (EIA) is compulsory in all types of new development. EIA is important to ensure that biological diversity is maintained and that development will not have any affect on the people and other species in that area. The aim of this study is to investigate the environmental impact on human wellbeing in the vicinity of quarrying. It will increase the awareness of the local population of the important factors that might affect the quality of their lives. A set of questionnaires was distributed to the community at Bandar Saujana Putra and Taman Kajang Perdana, in Selangor. A total of 60 residents were involved in the study. The results reveal that the community was concerned about health conditions and safety. However, there is still a lack of strategies to mitigate the problem. This study provides suggestions for mitigation that could be considered by the residents to reduce the effect of poor air quality caused by incorrect control and monitoring of activities in the area. It is anticipated that this study could assist both residents and authorities in improving the quality of the air as well as the residents' quality of life.

Keywords: Environmental Impact Assessment (EIA), quarry

1.1 Introduction

Quarrying is an important industry in national development. It provides much of the material used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even clay to make ceramic tiles and cement. However, like many other man-made activities, quarrying activities have a significant impact on the environment. For economic reasons they must continue to supply raw materials for construction, building and manufacturing. However, blasting rock in order to extract material can cause noise pollution, while dust from the quarrying is the main element in air pollution. Limestone produces alkaline dust particles, and coal mining that produces acidic particles. These chemicals have the potential not only to harm human health but also to destroy habitats and a variety of species (Mabogunje, 2008). Nevertheless, with proper planning and management this effect could be minimized.

The increase in population results in the spread of residential areas, with more housing to accommodate the growing numbers. However, the limited availability of land has always been an issue, and it is highly likely that residential zones will be developed near quarries (Ibrahim et al., 2019). According to Ng (2012), the balance between the environment and economic development needs to be adjusted, with legislation to improvement quarry management and provide preventive measures to preserve the environment. Section 34A of the Environmental Quality Act, 1974 - Amendment 1985 requires that an Environmental Impact Assessment (EIA)

*Corresponding author: emmamarinie@uitm.edu.my

report must contain measures to assess, prevent and reduce the impact on the environment. Following Wahid's study of 2010, of 49 EIA reports from 1995 to 2002 on housing construction activity, it was proposed that for quarrying or any other industry there should be a buffer zone of at least three kilometers from the site. However, due to the growth in population, a lot of housing has been built near quarries, with many negative impacts such as cracks in houses, broken roads, dirt and dust in the atmosphere, and noise from blasting (Ibrahim, 2009). The purpose of conducting this research is to identify residents' perceptions of the environmental impact in their area from quarrying. This study is anticipated to encourage preventive measures to reduce the impact.

1.2 Background Study

In Malaysia, the quarry industry is very important to the development of the economy. Quarries continuously supply raw materials to the construction, building and manufacturing sectors. The quarry mining economy is booming, along with the growth of the Malaysian economy and construction sector. They are two types of quarry in Malaysia, limestone and granite. Limestone is normally used as a raw material for cement, lime and in manufacturing sectors such as paper, paint, plastic, rubber and glass. Limestone and granite are also used to produce aggregate for road building. Limestone is a sedimentary rock embracing carbonate rocks or fossils. While granite is mostly silica and alumina, limestone is composed mainly of calcium carbonate or a combination of calcium and magnesium carbonate with varying amounts of impurities. Thus, limestone containing less than 5% magnesium carbonate ($MgCO_3$) is termed as calcite limestone and that containing more than 40% $MgCO_3$ as dolomite. The demand for natural resources will continue to affect the growth of national economic development (Ibrahim, 2009). However, research has found that these minerals aggregated with chemical compounds can cause health problems in humans, including dizziness, breathing difficulty, flu as well as eye irritation. According to Olusegun (2009), every component of chemical compounds inhaled into the lungs will harm the respiratory system; for example, the dust may cause silicosis, impairing health and in many cases leading to death. Suspended particulate dust also causes asthma, lung cancer, and cardiovascular issues and may result in early death. Respiratory illnesses such as asthma are especially aggravated by very fine dust, and even arthritis sufferers are affected. Dust from tin mining has a high silica content and will increase the incidence of silicosis and silico-tuberculosis in the region, as well as lung cancer and non-malignant respiratory infections. A high arsenic content in dust and smoke appears to have a more critical influence than crystalline silica in raising the mortality rate from lung cancer. Non-poisonous gases have an unpleasant impact, especially those which reduce the oxygen content (Ashraf, 2015).

Nartey et al. (2012) proved that quarrying will generate a large amount of particulate matter with a micron size that will be suspended in the atmosphere; a particle with an aerodynamic diameter of less than 10μm (PM10) can be transported over long distance. For example, dust pollutants can spread up to a distance of more than 5 km from the source (Aigbedion, 2007). Because of its tiny form, this particle can also enter and float inside houses, creating a high risk to residents, especially those near the quarrying area. Dust may occur as fugitive dust from excavation, from haulage roads, and from blasting, or can be from specific points such as drilling, crushing and screening. Site conditions that affect the impact of and particle size of dust generated during the extraction of aggregate include rock properties, moisture, ambient air quality, air currents and prevailing winds, the size of the operation, proximity to population centres, and other nearby sources of dust. Dust concentrations, deposition rates, and potential impacts tend to decrease rapidly away from the source (Langer, 2001). The weather conditions on the monitoring day may also influence the level of concentration measured. A study by Kapwata et al. (2018) showed that meteorological factors such as rainfall and humidity do affect the concentration of measured particulate matter.

The distance of houses to the quarry may not be the only factor influencing the mean concentration. The result may also be influenced by other sources such as the emissions from vehicles passing by the residential area and other construction activities around the sampled houses, adding to the level of PM10. Azarmi et al. (2014) stated that the potential generation of particulate matter includes coarse, fine, very fine and ultrafine particles from the construction activities. The level of indoor concentration is mainly be related to the outdoor concentration that penetrates indoors. Techniques to reduce exposure include the use of water trucks, sweepers, and chemical applications on haulage roads, control of vehicle speed, and construction of windbreaks and plantings. The impacts from plant-generated dust is commonly mitigated by use of dry or wet control systems. Dry techniques include covers on conveyors, vacuum systems, and bag houses which remove dust before the air stream is released into the atmosphere (Tarmizi, 2014). This air pollution needs to be monitored every day to make sure the preventive measures by the quarry management are being applied.

1.3 Methodology

An initial study on the background of the quarrying site was done by interviewing the owner of the quarry and the nearby residents. Two sites were chosen as the case study based on its distance between the quarry and the housing. The location of the site is shown in Fig 1 and 2. Systematic sampling was a suitable method for gathering data from the residents. The total population was 200. This is based on the early study conducted via interview with the representative from the residential. Two case studies were selected of residential areas within a one kilometre radius of the quarry. Nartey et. al., (2012) use a sampling method in which 65 residents were randomly selected for interview from two communities in Ghana within the area selected. The population were 200. The scope of questions in the interview concerned their social and economic perceptions of quarry activity and their level of health as affected by quarry activities. In line with the criteria listed above, in this research, the researcher is used randomly sampling for questionnaire survey to 60 respondents to investigate the impacts of quarries activities to the residences.

A questionnaire survey is commonly used as a needs assessment to identify which policies are the most pressing in a community, or assessing the public‘s knowledge and awareness. The questionnaire offers an ordered scale from which respondents choose one option that is best aligned with their view; that is, it measures respondents' attitudes by asking the extent to which they agree or disagree with a particular question or statement (Losby & Wetmore, 2012). A set of questionnaires were distributed to the selected residents to investigate the issues and the effects of the quarry's activities. The questionnaire was structured into three sections: background information, impact of quarry activities on the residential area and preventive measures. Sixty participants from two locations in Selangor were involved in the survey. The detail is as shown in Table 1.

Fig. 1 - Bandar Saujana Putra, Selangor

Fig. 2 - Taman Kajang Perdana 2, Kajang Selangor

Table 1 - The location of participants

Selected Location	No of Respondents	Distance from Quarry to Residential Area
Bandar Saujana Putra Taman Kajang Perdana	60	200m 400m 600m 800m 1000m
Total	60	1 kilometre

The survey was part two of the research design. As the literature pointed out, risk assessment and communication greatly depends on how people involved in the process perceive risk, and so this stage was important to find out how key residents perceive various impacts of the quarry on their health. Two residential areas were selected for the survey through purposive sampling. The selected resident sites were 60 two-storey terraced houses. The residents were asked to rank the probability of occurrence of the eight critical risks identified in stage two, on a 1-5 Likert scale. 1= very likely to occur, 2= likely to occur, 3= moderate, 4= not likely to occur, and 5= never likely to occur. Other parts of the questionnaire were designed to obtain the profiles of the respondents in terms of their level of involvement in construction, their gender, employment status, and level of education, construction-related qualifications and experience, exposure to impact from quarry activities and illness, and exposure to mitigation plans from the Department of Environment (DOE).

1.4 Data Analysis and Findings

a) Response Rate and Respondent Background

Data collection was conducted during March and April in 2018. Table 2 shows the breakdown the distances from their houses to the quarry site. Table 3 presents the number of respondents and their years of living in this area. The majority of respondents were housewives and elderly people, who spent most of the day at home.

Table 2 - Distance between quarry and residential area

Distance (m)	No of Respondents
<200	14
<400	10
<600	8
<800	7
>1000	21
Total	60

Table 3 - Numbers of years living there

Residency Duration	No of Respondent
<2 years	19
3 years	10
4years	7
5 years	8
6 years	5
>7 years	11
Total	60

b) Environmental Impact on Quarry Activities

In Table 4, the residents were asked for their experience of the temperature level. The results show that the majority agreed that the temperature is hot (46 responses). This is as expected because the surrounding area had little vegetation, which could be a factor in heating up the area. The result is reflected in the data in Table 5, where the majority of the residents rated the area as dry (34 responses) or extremely dry (14). Residents also complained that this condition affected their daily life; They needed to wear a face mask every time they went out of the house to protect them from suffering from the very dusty air.

Table 4 - Surrounding temperature

Surrounding Temperature	No of Respondent
Extremely Cold	0
Cold	0
Comfortable	10
Hot	46
Extremely Hot	4
Total	60

Table 5 - Air quality

Air Quality	No of Respondents
Extremely Dry	14
Dry	34
Comfortable	12
Humid	0
Extremely Humid	0
Total	60

Beside blasting, the other major factor contributing to poor air quality in this area is the transportation of the materials from the quarry site. The movement of vehicles produces dust. This upsets the balance between the volumes of oxygen and carbon dioxide, upsetting the balance in the environment and reducing the level or air quality (Lameed, 2011). During the data collection phase, the author therefore observed the movement of vehicles. The lorries transporting material from the quarry are very frequent, especially on blasting days, contributing to the high dust content in the air.

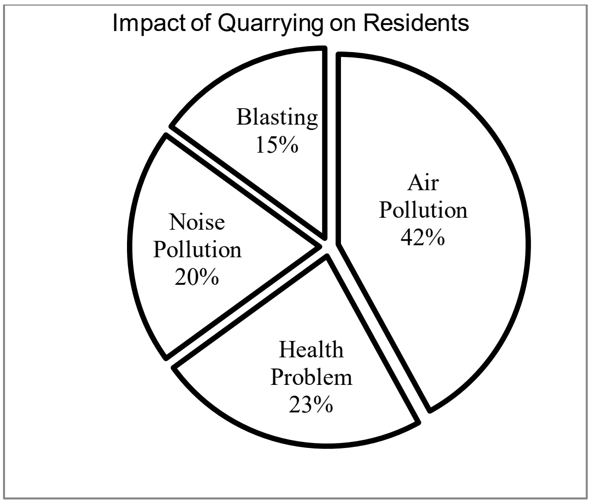

Fig 3 - The impact of quarrying on residents

The pie chart in Fig 3 shows the impact of quarrying on residents. The residents are most affected by the poor air quality resulting from the mining activities (42%), followed by health problems (23%) and noise pollution (20%), with blasting last (15%). According to Ibrahim (2010), the immediate operations of the quarry not only affect nearby housing, but there are also many complaints from the residents on other issues such as air pollution, blasting and general noise pollution. Tarmizi (2014) agreed that air pollution is the main problem as technical operations fail to follow established guidelines; for example, the conveyors used to move materials are left uncovered, so the dust is not prevented from spreading.

Table 6 - Residents' perception of quarry activities

No	Question	Yes	No
1.	Do residents have health problems due to quarry activity?	40	20
2.	Is your residential area affected by the quarry activities?	44	16
3.	Have the DOE's visits affected you?	46	14
4.	Has the DOE done anything to overcome the quarry activities' problems?	39	21

Table 6 is intended to identify residents' perceptions of nearby quarrying activities. It shows that 40 residents agreed that quarry activities do impact their health. 44 residents also agreed that their residential area is affected by the quarry's activities, from blasting to the number of lorries carrying quarry stone using public roads, resulting in dust and also noise and traffic congestion. Residents also agreed that despite visits by the DOE to witness the current environmental conditions, there had been no action to improve the conditions. The results of this survey could be a good starting point for both industry and the authorities to seriously play their role in solving community problems.

c) Preventive Measure

In the final section of the survey, residents were asked about the preventive measures that could be implemented in order to improve and reduce the impact of quarrying activities in their area. The measures suggested are listed in Fig 4. The results show that residents agreed that preventive measures could be successfully undertaken by both parties, the residents themselves and the authorities. However, it would need to be well organized to make everybody aware of the importance of protecting the environment. Action without appropriate study may lead to failure and waste of time, manpower and finance.

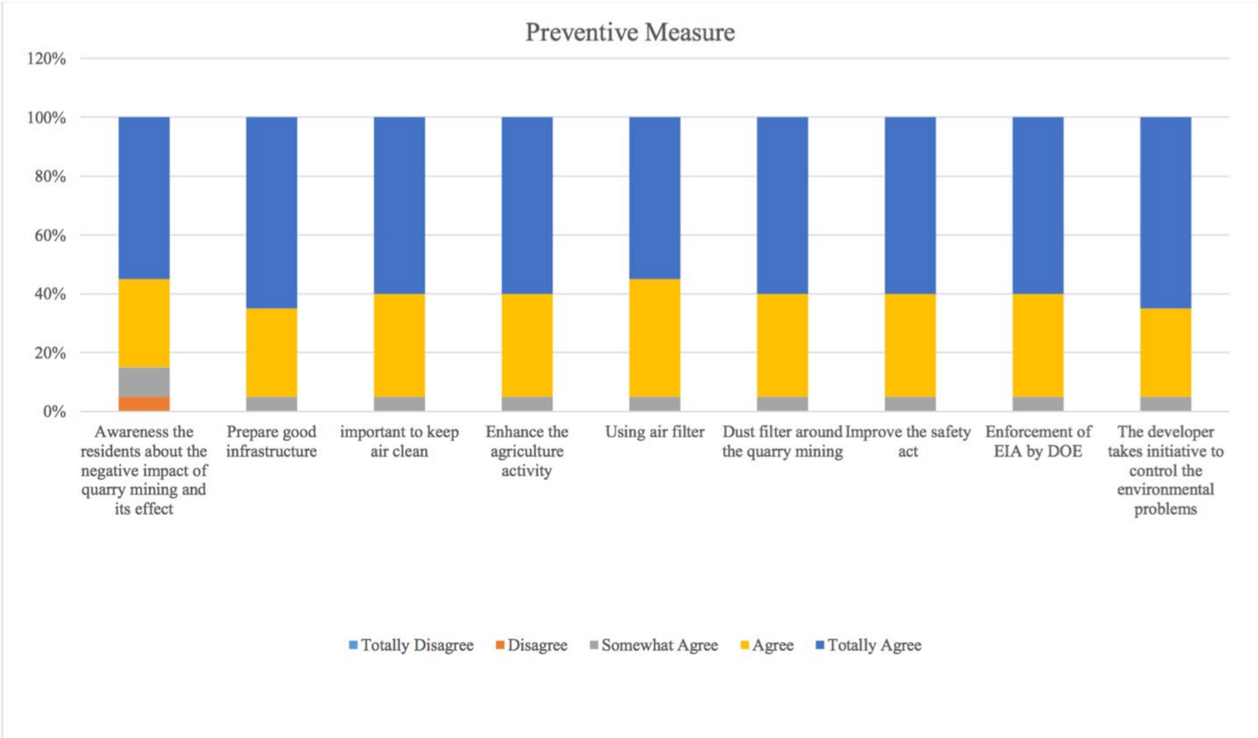

Fig 4 - Preventive measures to reduce the environmental impact due to quarrying activities

In order to minimize the ill effects of quarrying, certain precautionary measures must be taken by both the government and the quarry companies. The government's role is to provide and enforce the legislation required to make it mandatory for the companies to practise all necessary precautions in their operations to prevent or minimize environmental damage. Such legislation already exists in our country. Apart from stating unequivocally the conservation methods which must be employed in quarrying operations, the new law has not made sufficient provision for sanctions against those who fail to comply with the environmental protection regulations. In some cases there is a need to strengthen the existing law, such as (i) quarrying companies should submit environmental restoration plans together with their application for either prospecting or quarrying leases of an area; (ii) quarrying companies must install appropriate equipment, where necessary, for preventing or minimizing pollution; (iii) all large quarrying and processing companies are to prepare a prognosis of the possible environ-mental impact of their operations, as well as techniques for monitoring the impact for approval by the DOE before the companies can commence operation.

Amendments to existing guidelines are also suggested, based on studies conducted overseas as well as on proposals from parties involved in the Malaysian quarry industry. These amendments are limited to the development of activities solely within the quarry application phase, rather than after the application have been approved by the local authority. First, the quarry organization must ensure that its activities follow the Environmental Impact Assessment (EIA) required by the Department of Environment (DOE), as shown in Table 7.

Table 7 - Suggested activities

Number	Aspects to be considered
Prevention	avoiding the main area
	controlling access
	reducing the area that needs to be cleaned
	avoiding clearing trees, uncontrolled
	limiting quarry operations
	protecting the flora of dust
	avoiding clearing small habitat
Reduction / control	relocation of species
	installing pollution control devices
	controlling sediment traps
	avoiding interference
	regulation and supervision by an expert
Repair	sediment
	landscaping
	habitat restoration
	replanting of trees
	resettlement habitat
	replacement habitat

(DOE, 2009; Wahid 2016)

The developer should take the initiative in controlling environmental problems in the vicinity of housing. Hence, mitigation strategies on the handover of quarries should be identified to assist the parties in determining which applicants are eligible for permission or approval to carry out quarry activities. The guidelines will be formulated by balancing the needs of the state's economy, the protection of the environment and the safety of local people, as well as outlining the criteria required of the applicant in applying for quarry activities. The EIA needs to lay down appropriate rules and the local authorities must be stricter in enforcing them. The guidelines must incorporate the proposed recommendations shown in Table 8.

Table 8 - Preventive measures

No.	Preventive Measures
1	Spreading the information to the residents about the negative impact of quarrying and its effects.
2	The local authority needs to prepare a good infrastructure to overcome air pollution in residential areas.
3	The local authority needs to spread information to the community on the importance of maintaining clean air.
4	Enhancing agricultural activity around the residential area to filter out the quarry dust.
5	Using air filters to keep air clean.
6	Increasing the use of dust filters around the quarry.
7	Improving the Safety Act for housing construction near the quarry.
8	The quarry organization must follow the EIA rules prepared by the DOE.
9	The developer should take any initiative to control environmental problems around the residential and quarry areas.

It can be concluded that the issues of air quality, dust from quarrying, air pollution and lack of enforcement lead to the ineffectiveness of preventive measures provided by the DOE. Hence, the DOE should take action to provide good air quality for housing near quarries, with cooperation from quarry management and developers to achieve a sustainable quarry environment. The preventive measures listed in Table 8 include new factors for the DOE to consider.

Analysis of the quantitative data collected has resulted in recommendations proposing new mitigation strategies for residential areas near the quarries. Residents, local authorities, quarry management and the government all have roles in achieving effective implementation in managing the air quality. All the parties need to pay more attention in order to achieve a sustainable quarry industry.

In particular, the impact of quarrying on air pollution must be overcome. The primary role of government must be to enforce the legislation and regulations controlling quarry activities. The roles of the authorities need to be restructured. Furthermore, an environmental plan should include procedures for monitoring quarrying activities throughout Malaysia. In short, monitoring and inspection by government authorities are very important to ensure the private sector implements the regulations effectively. This should be supplemented by targeted awareness campaigns, seminars, workshops and other activities for residents and the private sector to increase knowledge of quarrying activities in Malaysia. By implementing these proposals effectively, residents can enjoy sustainable development now and in future.

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