

ENVIRONMENTAL IMPACT ON RESIDENTS' WELL-BEING IN THE VICINITY OF QUARRYING

Wan Hasmirah Wan Ibrahim¹, Emma Marinies Ahmad Zawawi¹, Julitta Yunus¹,
Nurfashiha Hashim¹, Khalida Mohd Sukur¹

¹*Faculty of Architecture Planning and Surveying, Universiti Teknologi MARA, Shah Alam, Selangor*

*Corresponding author: wwanhasmirah@yahoo.com.com

Abstract

This study investigates the quality of life of the large population living in the vicinity of quarrying. The negative impact of quarrying activities, such as health problems and air pollution is among the variables that influence human well-being. The objective of this study is to investigate the residents' experience of air quality in their area and to provide suitable preventive measures to reduce air pollution. A set of questionnaires was distributed to the community at Bandar Saujana Putra and Taman Kajang Perdana, in Selangor. Residents were randomly selected to participate in this study. The study reveals that the community was concerned about health conditions and safety. It is anticipated that this study could assist both residents and authorities in improving the quality of air in this area by providing suitable preventive measures to reduce the environmental impact.

Keywords:

Air Quality, Quarrying Activities, Environmental Impact

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INTRODUCTION

Quarrying is an important industry in national development. For economic reasons, it needs to continue to supply raw materials for construction, building and manufacturing. However, to sustain this development, both industry and government agencies must take responsibility for controlling its activities. Population increase may result in the spread of residential areas. 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, 2009). This scenario may worsen the level of the Air Quality Index (AQI), as the dust from quarry sites is a major source of air pollution. According to Ng (2012), the balance between the environment and economic development needs to be improved, with legislation to improvement quarry management and provide preventive measures for preserve the environment. Section 34A of the Environmental Quality Act, 1974 - Amendment 1985 requires that an Environmental Impact Assessment (EIA) report must contain measures to assess, prevent and reduce the impact on the environment. Following Wahid's study (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 investigate the experience of residents towards the quality of air near their homes and to recommend preventive measures in the face of quarry activities. In the past, the growth of the industry was not an issue as most quarrying was far away from residential areas and people. However, with the passage of time and the rapid growth of population, the increased number of housing projects has pushed building near the quarries (Tarmizi, 2014). Hence, the aim of this study is to identify the residents' perception of air quality near their homes.

METHODOLOGY

Sampling and Survey

This study used a random sampling technique. Two case studies were selected of residential areas within a one kilometre radius of a quarry. A set of questionnaires were distributed to the selected residences to investigate the issues and effects on them from 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, as shown in Table 1.

Table 1: The location of participants

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

Questions were asked on the impact of quarrying on residents, their perceptions about quarrying activities, their health, and mitigation plans to overcome the problems. In accordance with the nature of quantitative research, the data was collected until saturation point was achieved.

Findings

All data collected was analysed using Microsoft Excel version 2010, and the findings are discussed below:

Table 2: Distance between quarry and residential area

Distance (m)	No of Respondents	Percentage (%)
<200	14	23.33 %
<400	10	16.67%
<600	8	13.33%
<800	7	11.67%
>1000	21	35%
Total	60	100%

Table 2 shows the number of respondents at 200 metre intervals from the quarry. The majority of respondents were housewives and elderly people, who spent most of the day at home.

Table 3: Surrounding temperature

Surrounding Temperature	No of Respondents	Percentage (%)
Extremely Cold	0	0%
Cold	0	0%
Comfortable	10	16.67%
Hot	46	76.67%
Extremely Hot	4	6.66%
Total	60	100%

Table 3 provided data on residents' satisfaction with the ambient temperature. The majority (46) found it to be hot and only ten rated it as comfortable. From observation in this area, fewer trees had been planted within the compound, which could be one of the factors contributing to the less comfortable temperature in this area. In addition, carbon dioxide emissions from burning gasoline for transportation contribute to global warming (Lameed, 2011), so the movement of lorries in the quarry area also affects the residential area.

Table 4: Air quality

Air Quality	No of Respondents	Percentage (%)
Extremely Dry	14	23.33%
Dry	34	56.67%
Comfortable	12	20%
Humid	0	0%
Extremely Humid	0	0%
Total	60	100%

Air quality is an important indicator in evaluating human well-being. Table 4 shows that the majority of the respondents (34) agreed that the air in this area is dry, and 14 rated it as extremely dry. That is, most respondents were not satisfied with the quality of air in their locality.

One of the reasons for poor air quality control 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, hindering the purification of the environment and reducing the level or air quality (Lameed, 2011).

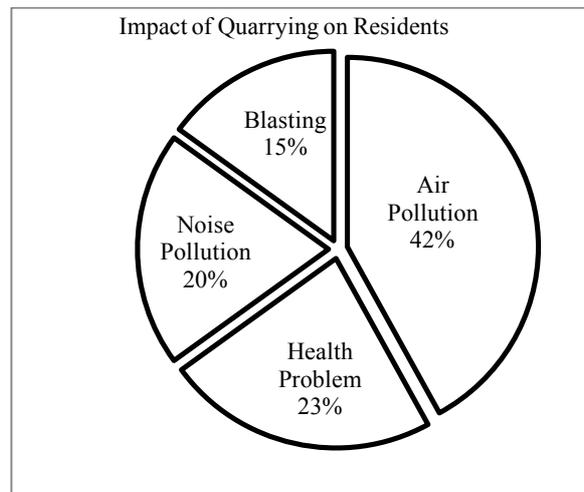


Figure 1: The impact of quarrying on residents

Figure 1 shows the impact of quarrying on residents. Air quality is most affected by the mining activities (42%), followed by health problems (23%) and noise pollution (20%), with blasting last (15%). According to Ibrahim (2010), the operations of the quarry not only produce affecting 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 5: 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

This part is intended to identify residents' perceptions of nearby quarrying activities. Table 5 shows that 40 respondents agreed that quarry activities do impact their health. Forty-four 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 routes, 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.

In the final section, respondents were asked about preventive measure that could be implemented in order to improve and reduce the impact of quarrying activities in their area. The measures suggested are listed in Table 7. Respondents agreed that preventive measures could be successfully undertaken by both residents and authorities. However, it would need to be strategized 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.

A review of mining activities is necessary to understand where dust originates in mining operations, and the environmental factors affecting dust emissions. Since the focus of this research is on surface mining operations, the review will concentrate on this aspect. A further consideration is that dust from surface mining operations affects the workers as well as spreading to nearby residential properties, resulting in health and safety effects on people and animals, damage to property through the deposition of dust, visibility issues, and the nuisance of the deposition of dust (Abdul Manan, 2015).

From the agricultural view, released dust not only settles on land, plants and trees but also on surface water, with various negative impacts on the ecosystem as a whole. Furthermore, fertile soil is moved, and after excavation pits are left unfilled or abandoned. This is not only unsightly but also poses danger to livestock, wildlife and people (Tahseen, 2016). According to Osuocha (2016), crop farming in the quarry environment and irrigation of plants with water from hand-dug wells in the area should be discouraged. However, trees reduce the dust problem, and planting more trees at the site and along the highway can work to trap the dust.

As already explained, there must be a balance between the economic importance of quarrying and its impact on the environment and biodiversity. Plants represent the main component of the ecosystem, playing a major role in maintaining the ratio of oxygen and carbon dioxide through photosynthesis and the level of the Air Quality Index (AQI). To ensure the balance between the environment and economic development, the legislation needs to be introduced to improve quarry management and provide mitigation strategies for preserving the environment. To summarize the findings of Tahseen (2016), quarrying industries produce high concentrations of particulate matter and dust, which negatively affect the study area, including the water and soil which are vital resources for agriculture, thus exacerbating the problem. With the increase in locating housing developments near quarries (Tarmizi, 2014), people also need to be protected and the level of Air Quality Index (AQI) improved. While residents themselves can use air filters to keep the air clean in their houses, again legislation is required to create the

necessary improvement in quarry management and introduce preventive measures for preserving the environment and residents' well-being.

Therefore, amendments to existing guidelines are suggested, based on studies conducted overseas as well as on proposals from parties involved in the 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 show in Table 6.

Table 6: Summary of Environmental Impact Assessment (EIA)

Number	Aspects to be considered
prevention	Avoid the main area controlling access reduce the area that needs to be cleaned avoid clearing trees, uncontrolled limiting quarry operations protecting the flora of dust
Reduction / control	Avoid cleaning small habitat relocation of species installing pollution control devices controlling sediment traps avoid interference
Repairer	regulation and supervision of an expert sediment Landscaping habitat restoration replanting of trees resettlement habitat replacement habitat

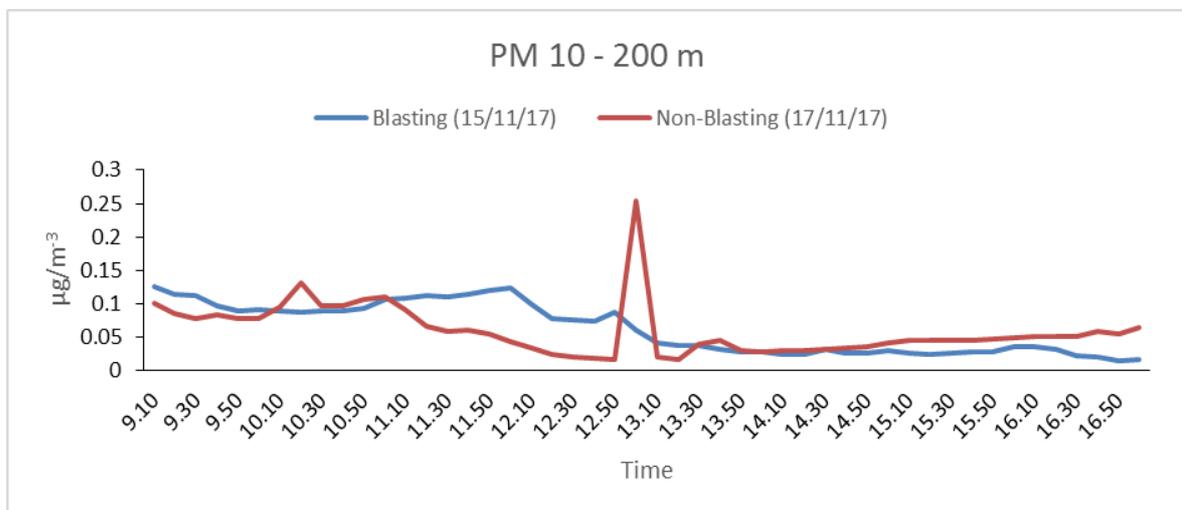
(DOE, 2009; Wahid 2016)

The developer should take any initiative to control 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. to the guidelines must incorporate the proposed recommendations shown in Table 7.

Table 7: 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

In order to measure the air quality (PM₁₀ level, i.e. particulate matter measuring under ten micrometres), five houses at different selected distances from the nearby limestone quarry were chosen for this study. The PM₁₀ real-time data were measured at 10-min average using a real-time light-scattering instrument TSI 8533 Dust-track Drx Desktop Aerosol Monitor. These data are used to examine the influence of mining activities (blasting and non-blasting) within variations of PM₁₀ concentrations inside residential buildings. The results indicate that within-day variability of indoor PM₁₀ was influenced by both the occupant's activities and outdoor surrounding activities such as blasting and vehicle movements. Eight-hour concentration mean values of PM₁₀ showed the influence of quarry activities on the indoor particulate concentration. See Figures 2-6.

Figure 2: Measurement of PM₁₀ at 200m on blasting and non-blasting days

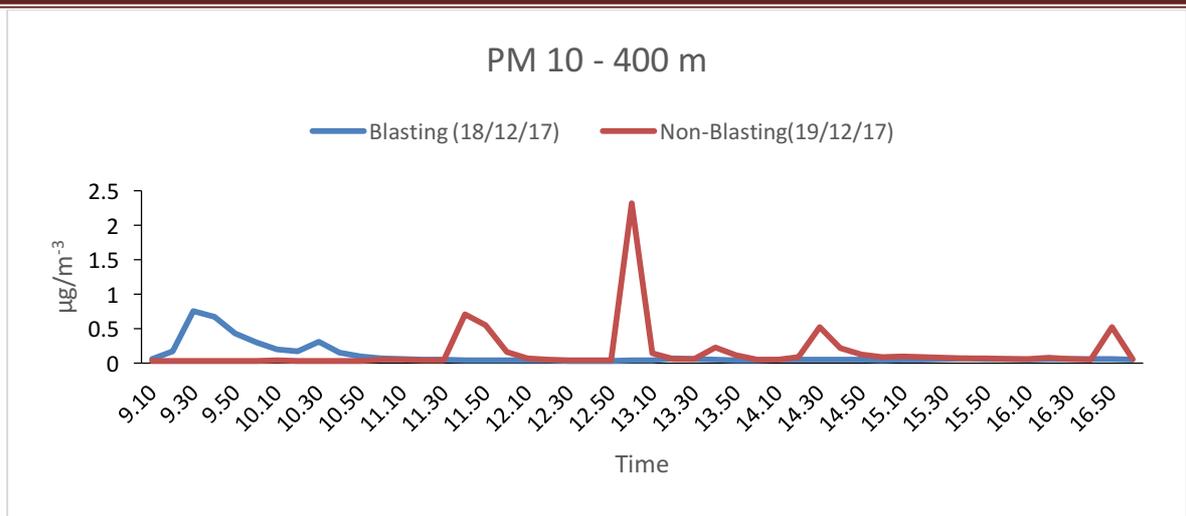


Figure 3: Measurement of PM10 at 400m on blasting and non-blasting days

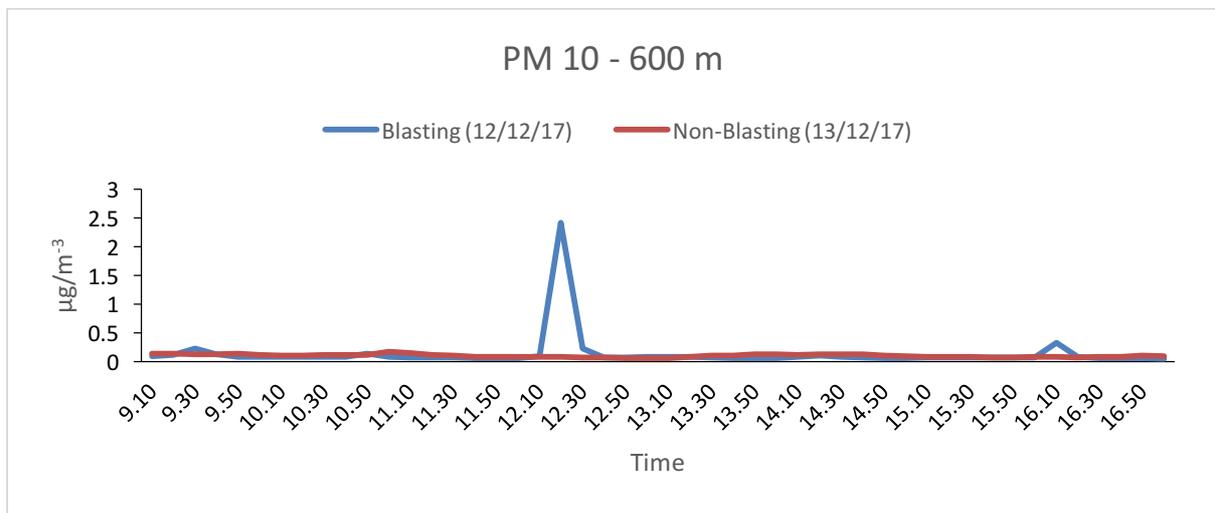


Figure 4: Measurement of PM10 at 600m on blasting and non-blasting days

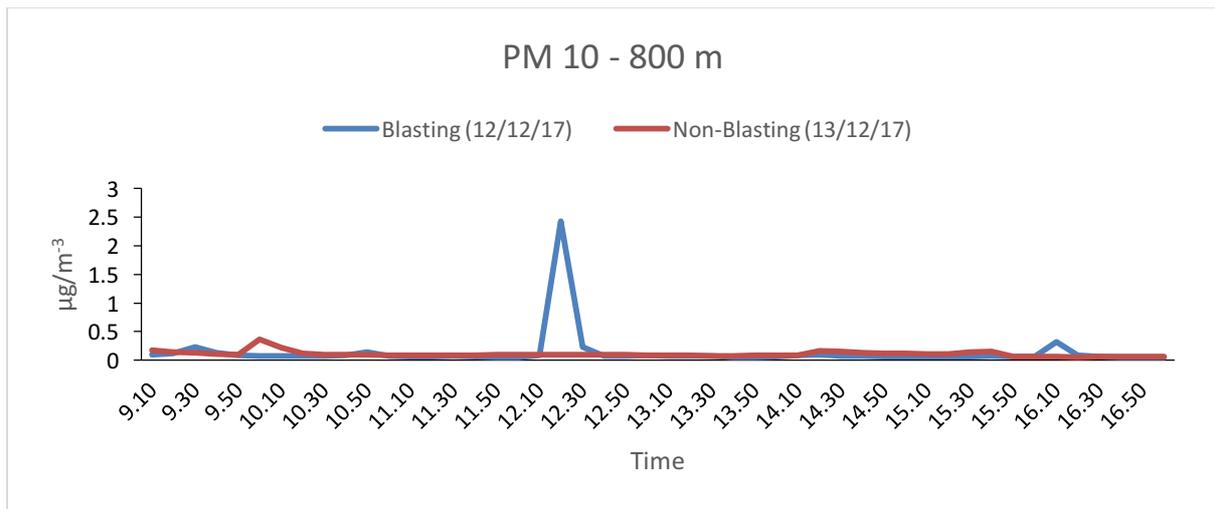


Figure 5: Measurement of PM10 at 800m on blasting and non-blasting days

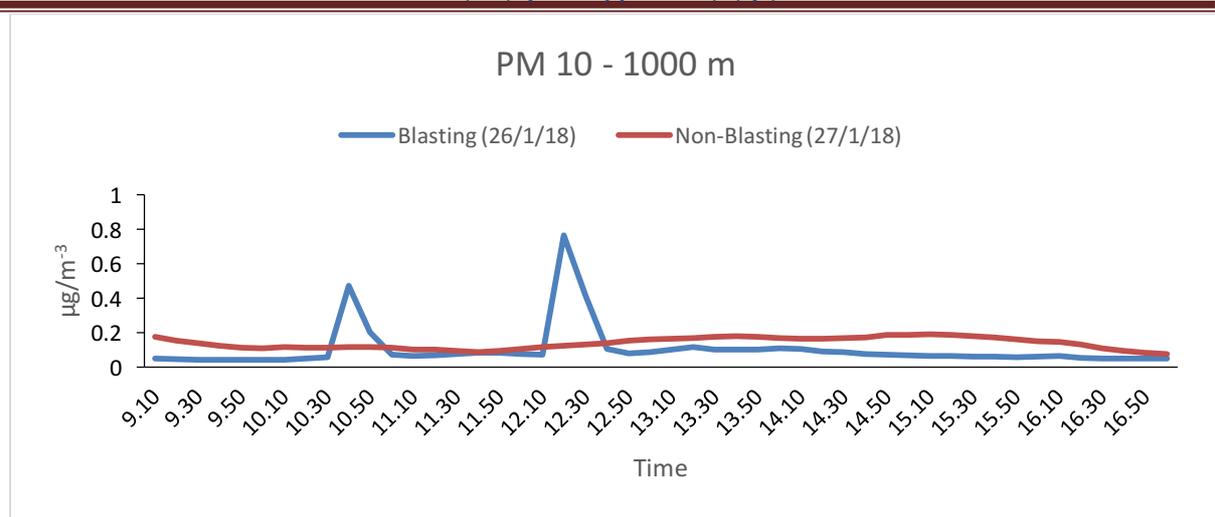


Figure 6: Measurement of PM10 at 1000m on blasting and non-blasting days

It was noted above that outdoor activities influence the concentration level of PM10. According to Darus et al. (2012), the penetration of outdoor emissions does affect the indoor concentration, as reflected in the tables presented above. Previous study done by Nartey et al., (2012) proved that the quarrying will generate a lot of particulate matter with a micron size that will be suspended in the atmosphere was mention in their study that the particle with aerodynamic diameter of less than $10\mu\text{m}$ can be transported over long distance. The particulate matter may be transported over a further distance. On top of that the weather conditions during the monitoring day may also giving influenced to the measured concentration. A study done by Kapwata et al., (2018) proving that the meteorological factors such as rainfall and humidity does effecting the concentration of measured particulate matter.

The distance of house to the quarry may not be the only factor influencing the mean concentration. This result may also be influence from the other sources such as the emission from the vehicle considering the location of the residential area. Besides, there are few construction activities being done surrounding the sampling houses. This may also add to the increase level of PM10. Azarmi et al., (2014) stated that the potential generation of particulate matter which include course, fine, very fine and ultrafine particles from the construction activities. The level of indoor concentration are mainly be related to the outdoor concentration that penetrate indoor. A good preventive measure is the major way in preventing the exposure.

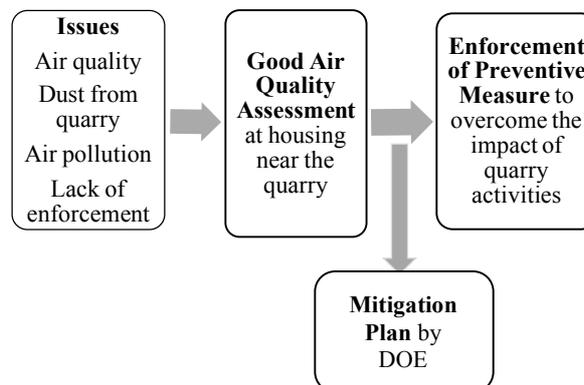


Figure 7: Key factors in quarrying activities

As illustrated in Figure 7, it can be concluded that the issues of air quality, dust from quarrying, air pollution and lack of enforcement factors 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 7 might be 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 achieving the effectiveness of 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 enhance knowledge of quarrying activities in Malaysia. By implementing these proposals effectively, residents can enjoy sustainable development now and in future.

Conclusions

This study reveals that residents are strongly affected by the quarrying activities, with regard to air quality, cleanliness and noise level. While relying on local authorities to play their part, residents themselves could consider how to reduce the impact of quarrying, for example by planting more trees around their housing and using air purifiers. However, local authorities and the DOE still need to revise their plans and take immediate action to improve the environmental impact in this area. This study is anticipated to benefit both residents living near quarries and the authorities in further investigating the real situation and providing solutions. The analysis of measurement of indoor dust samples in houses in this study showed the distribution and concentration of PM10 within the area of study. The concentrations were influenced by their surrounding environment, including the limestone quarry. Therefore, good housekeeping practice and good maintenance of ventilation systems should be taken into consideration in order to reduce contamination by dust in houses.

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