

## Air quality assessment on human well-being in the vicinity of quarry site

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**Abstract.** This study aims to investigate the variation of air pollutants associated with the quarry activities prior to classified distance from quarry site. Air pollutants were monitored with the use of instruments which are Rae System Multirae Lite Pumped (PGM-6208) to measure indoor air quality while TSI 8533 Dusttrack Drx Desktop Aerosol Monitor to measure outdoor air quality. Sampling will be replicated two times. The locations of quarry are at Bandar Saujana Putra and Taman Kajang Perdana 2, Selangor. The objectives of this study are to investigate the impact of quarry mining by preparing the suitable Indoor Air Quality Index and to prepare preventive measure for residential that caused from quarry mining activities. Both Qualitative and Quantitative approaches will be implemented in this study, which employed case study and interview survey. Both quarries identified previously will be the main case study. The Respondent's interviews are from Local Authority and Quarry Management Staff while questionnaire surveys from selected residences. Measurement method will be used to measure the Particle Matter (PM<sub>2.5</sub>) for indoor and outdoor in selected resident's area. However, this paper is primed to discuss the method used in this study. It is not only presents the beneficial information for future research on methodologies employed but also it is anticipated the benefit to environment which can increased residents' well-being in the vicinity of quarry sites.

### 1. Introduction

Quarry industry is one of the important industries in the development of country. For the economic development of the country, quarry industry continues to supply the raw materials for the construction, building and manufacturing. However, to sustain the supply and meet the development targets, both parties from industry and the government agencies must take all responsibility to control the consequences. Despite, the rapid growth of population and expanding of the housing development had forced the residential areas being built near the quarries [1]. This limitation of land issues had led to the high potential of more residential will developing near the quarry mining. The scenario is resulting is the level of Air Quality Index (AQI) for indoor environment become worsen. This is alarming for people's health and welfare, where 100% of a typical person's spend their time indoors. With regard to



air quality, previous studies categorised five particles in the air quality index as suspended particle (PM<sub>2.5</sub>), suspended particle (PM<sub>1.0</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), and volatile organic compounds (VOCs).[2] Many researches had been utilized not only to understand this scenario but also analysed the facts and synthesis the problems with solutions in the end.

This paper is concentrating in research methodology particularly in procedure utilized for collecting and analysing data for air quality assessment in vicinity of quarry site.[2] This research will involve mixed method. Both qualitative and quantitative methods were applied.

First, interview session was conducted which involved participation from Local Authority and Quarry Management Staff. Secondly, the questionnaire surveys will be distributed to the selected residents to investigate the issues affects quarry activities. Thirdly, the measurement of air quality level will be conducted at the quarry neighborhood.

## 2. Literature Review

### 2.1. Analysis of document review on Quarrying

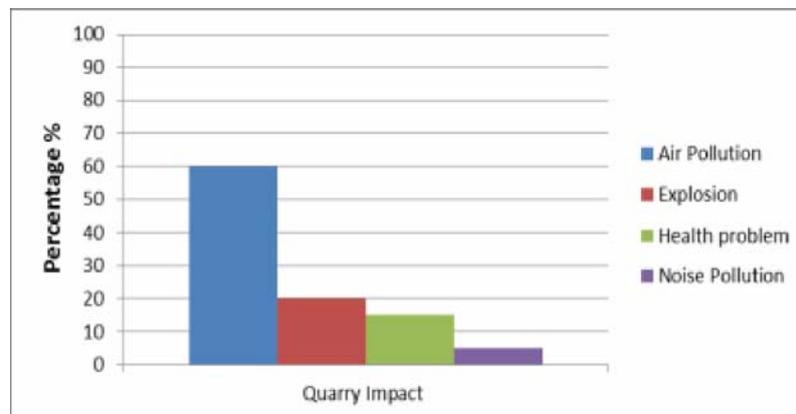
Documents were retrieved from reliable sources namely Science Direct, free access journal and Annual report of Department of Environment. The search criteria used the specific keyword “Quarrying in Malaysia and Indoor Air Quality (IAQ) in Malaysia” within years. There is an escalation of publication on quarrying-related research between 2007 and 2016. The pattern indicates an increased in the used of mixed methods approach compared to the single method. Table 1 shows the common research method applied e.g. Published interviews, case study, measurement and Environmental Impact Assessment (EIA) analysis. [3]

**Table 1.** Common research method utilised in the study

No	Research Approach	Descriptions
1.	Interview	This technique used by researcher to get involved and discuss the situation for a better understanding of the study.[4]
2.	Case Study	This enables researcher to closely examine the data within a specific context in order to explore and investigate the real-life phenomena.[5]
3.	Measurement Method	Techniques of real-time data collection from site, the parameters will be measured at the selected locations. For this study, PM <sub>10</sub> concentrations will be measured at residential near the quarry mining area. The data obtained from each location will be plotted between distance and air quality level.[6]
4.	Environmental Impact Assessment (EIA)	Reports studied began from the year 1995 to 2002 and it contains the assessment, prevention and reducing method of the impact for environment. [7]

**Table 2.** The relationship between distances of residency to and the quarrying impact

Distance to Quarry Site (m)	Quarry Impact				
	Affected Respondent	Air Pollution	Explosion	Health Problem	Noise Pollution
<200	6	6			
401-600m	6	4	2		
601-800m	3		2	1	
801-1000m	3			2	1
>1000m	2	2			
Total		12	4	3	1



**Figure 1.** The impact of quarry

Table 2 shows the relationship between distances of residency and the quarrying impact of affected respondent. While, figure 1 shows the impact of quarry activities to the resident's. The most quarry impact affected the residents are air pollution, explosion, health problem and noise pollution. As results, the distance of residency to the quarrying area also played roles where neighbourhood within 200m of quarrying are most affected with air pollution.

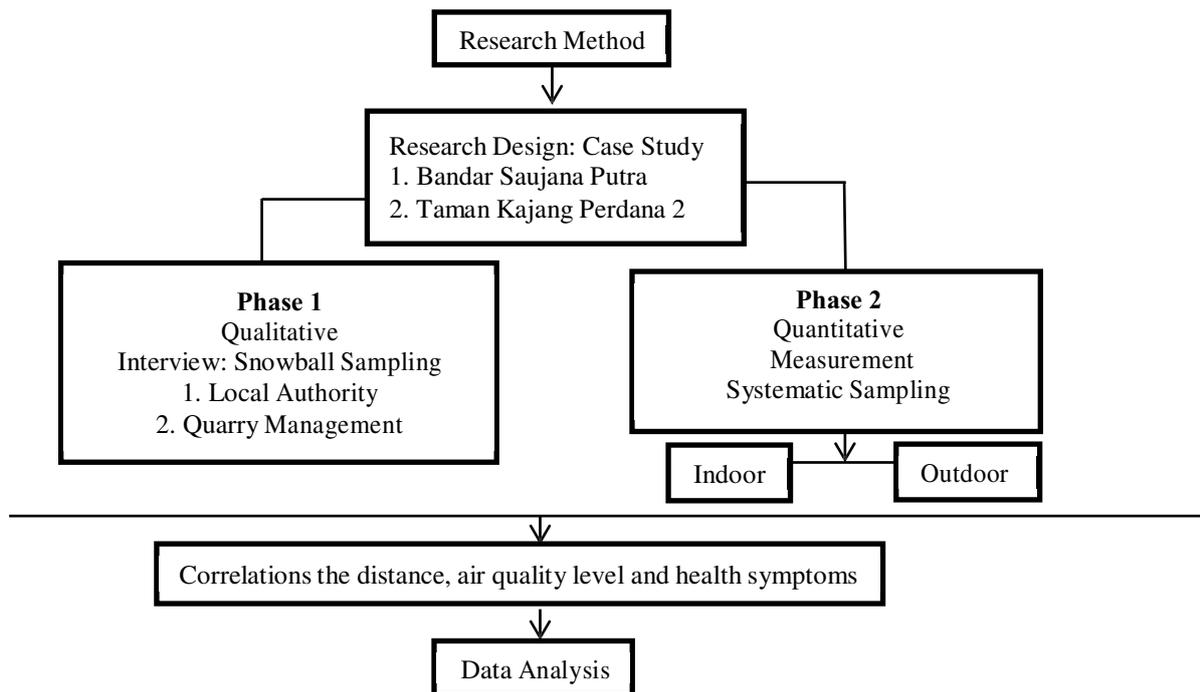
### 3. Methodology

#### 3.1 Sampling

Referring to Nartey, Nanor and Klake [8], the sampling method that had been practiced in their research where residents were randomly selected from two communities in Ghana based on the area located. 65 residents were selected for interview sessions. The scope of questions in the interview concerned to their social economic, perception on quarry activity and level of people health due to quarry mining activities. [8] While, cases for this studies were selected from residents at Bandar Saujana Putra and Taman Kajang Perdana 2 in Selangor within 1 kilometre (km) perimeter radius of the quarry mining. The characteristics of the houses within the distance of quarries in residential areas are shown in Table 3. Twenty (20) residents were chosen as the respondents from each case study. The scope of surveys were asked on impact of quarrying to resident, perceptions' about quarrying activities, resident's health experiences and mitigation plan to overcome the problems. The overall process of research in order to achieve the aim and objectives illustrated in the Figure 2.

**Table 3.** The Location of Selected Case Study

Selected Location	Type of House	No of Houses	Distance from Quarry To Residential Area
Bandar Saujana Putra, Kuala Langat, Selangor	Terraced House – Double Storey	10	200m 400m 600m
Taman Perdana Kajang 2, Kajang, Selangor		10	800m 1000m
Total		20	1 kilometres



**Figure 2.** Flowchart of Research Method

### 3.2 Interview: Snowball Sampling

The first phase of data collection was the interview by using snowball sampling. Snowball sampling conducted to facilitate the identification of other members of population. The criterion for the sampling subject was only the Local Authority in Selangor. The interview was conducted to gain the information on current problems faced by the management of the quarry in their efforts to operate the activities of the quarry, the implementation of the existing guidelines and awareness of quarry management to the residential. Selected samples should be consisting of policy makers from government involvement to dust management. Due to the nature of qualitative research, the data was collected until saturation point is achieved. The interviews were designed in semi-structured interviews while process of data collection has conducted face to face interviews.

### 3.3 Measurement of AQI

The second phase of data collection is real-time measurement. It will involve the use of instruments that measure Air Quality Index (AQI). The measurement will be taken indoors, for houses located near the quarry. The parameter of air quality logged in this real-time measurements are PM 2.5 and PM10. Measurements will involve the level of oxygen (O<sup>2</sup>) amount, carbon dioxide (CO<sup>2</sup>) and any Particle Matter (PM2.5) in each house. According to the Air Pollutant Index (API) guide, published by the Department of Environment Malaysia (2000), [9] the air pollutants included in Malaysia's API are ozone (O<sup>3</sup>), carbon monoxide (CO), nitrogen dioxide (NO<sup>2</sup>), sulphur dioxide (SO<sup>2</sup>) and suspended particulate matter of less than 2.5 microns in size (PM2.5) which are potentially harmful to human health. The instruments that will be used are Rae System Multirae Lite Pumped (PGM-6208) for measurement of indoor air quality and TSI 8533 Dusttrack Drx Desktop Aerosol Monitor for measurement of outdoor air quality [10] Different levels of air pollution signify conditions for alert, warning, emergency and significant harm. The correlations of the distance, air quality level and health symptoms will be analyse at the later stage to provide a stronger finding on impact of quarrying.

#### 4. Conclusion

It is hoping, implementing the mixed methods, researcher would be able to identify and propose possible modification to overcome the impact of quarrying activities. This paper outlines the information for future researcher with regards to methodologies aspects and understanding the pattern of research methods on quarrying issues. The next step is to propose the preventive measure from the analysis of indoor air quality (IAQ) assessment based on the real-time measurements. In conclusion, it is hoping that the preventive measure will be beneficial to the quarry management as a guide to reduce the environment effect in surrounding areas. It also hopes it will aid the professional agency to overcome the issues of air pollution especially from the dust due to quarry mining. Finally, this study will be able to provide more knowledge and understanding on decreasing environmental quality by air pollution, which then aided in improving the comfortable condition of residents in their own houses.

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