

PERCEPTION ON QUARRYING ACTIVITIES AND POST QUARRIED LAND USE ALONG RIVER NDARUGU, KIAMBU COUNTY

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Abstract

Post-quarried sites require an informed management system in order to reduce environmental pollution as well as generate economic benefits for the land owners. Ndarugu region of Juja, Kiambu County has experienced long term quarrying for the benefit of contractors. However, the post-quarry sites have largely been neglected creating an environmental scar on the landscape. A survey was undertaken between February 2015 and May 2015 to investigate the perception of quarry land owners on quarrying activities and post quarry land use. The survey was conducted along a transect parallel to the river ridge where quarrying activities are concentrated. The semi-structured questionnaire schedule addressed issues of quarrying impact, post quarried land use preference, expected benefits of rehabilitation and limiting factor for rehabilitation. From the study, it was found that majority of quarry owners were small scale farmers (63.2%) who identified crop farming and dairy farming were identified as the most preferred post quarried land use. 89.5% of the respondents revealed that quarries occupied more than 25% of their land. 31.6% of the quarried land was abandoned without backfilling, 31.6% of the quarry land was back-filled without levelling, 21.1% still being quarried while 5.3% were backfilled levelled. Increase in household income and water pollution were the strongly agreed positive and negative impact of quarrying. Increase in income and reducing health and hazard risk associated with quarrying to most perceived benefit of quarry rehabilitation. Lack of finance and the quarry rehabilitating firm not undertaking its responsibility were found to be the greatest limiting factors for post quarry land rehabilitation. Quarrying thus was found to impact on the social economy of the community around the study area. A cost effective rehabilitation method thus needs to be identified that affordable to the quarry owner and one that will ensure economic gain from the quarried land.

Key words: Land owners, *land division*, quarrying impact, *rehabilitation methods*, livelihoods,

1.0 Introduction

Over the past century, Quarrying of building stones and other building material have been on the rise due to increased demand for building material (Dong-dong et al. 2009). This has been enhanced by the increased rate of urbanization locally and internationally (Dong-dong et al. 2009; Lad & Samant 2014). Quarrying is undertaken in different parts of the world. Quarrying activities impact on the environment and the social economic status of the people (Lad & Samant 2014). The impact on the social economy can either be positive or negative (Lad & Samant 2014; Chatterjee 2010; Bamgbose et al. 2014). However, the environment is negatively impacted through loss of biodiversity, dust pollution, water pollution, lowering the water table, insightful scars (Jim 2001; Chatterjee 2010) and noise pollution (Dong-dong et al. 2009; Weston et al. 1999). The quarried land left behind too impact the environment and the society though the extent of its impact depends on the post quarrying management put in place (Kaliampakos & Mavrikos 2006).

There are many challenges that faces the community that reside near the quarried land areas (Bamgbose et al. 2014). The social economy impact of quarrying determined the perception of people towards quarrying. Some of the positive impact to the society includes increase of peoples income, improved infrastructure and job creation (Weston et al. 1999; Chigonda 2010). The negative impact on the livelihood of the people related to increase health risks from air and dust pollution such as pneumonia, eyes and ears infection and other respiratory diseases (Nartey et al. 2012), accidents due to open quarry pits, water source pollution, change in the social ethics, illegal stone quarrying and increase in conflict in the society (Lad & Samant 2014).

Even with the presence of negative impact of quarrying activities on the society and the environment, campaign for quarry re-greening (Dong-dong et al. 2009) in the aim of reducing the impact of quarrying, enhancement of

sustainable development and economical gained from the abandoned quarries have increased in the recent past (Mendes et al. 2014). This forms the basis for quarry rehabilitation and post quarried land use. There are many rehabilitation methods that have been used across the world in enhancing the condition of the quarried land to enable reuse of the land after quarrying ceases (Dal Sasso et al. 2012). They include afforestation (Jim 2001), creation of dams, Agriculture use and creation of recreation site (Milgrom 2008).

Well planned post quarried land use have been found to have various positive impact on the environment and the society living close to the quarried area. The impacts includes economical gain by the society, creation of animal habitats, reduction of hazardous nature of quarried land, sustainable development of the local community, increase biodiversity, of education and water conservation (Rushworth & Budnik 2012).

The current concern in the world is sustainable development that integrates environmental concern in sustainable utilization of the natural environment. Quarrying activities have detrimental impact on the environment apart from its economies benefits. The environmental impact and other social economic negative impact of quarrying have formed the foundation of conflicts between quarrying firms and the communities around the quarrying area (Lad & Samant 2014). Understanding the perception of the communities around the quarry area on issues related to quarrying and post quarry state of the quarried land is of significance as it influences their relationship with the quarrying firms and the post status of the quarried land.

The area along Ndarugu have for a long time be a source of building stone for areas surrounding the quarry areas. Therefore, the Quarried landscape increases each passing day and so does the impact on the environment and the society. A study was thus conducted to establish the perception of the people who live around the quarries along the ridge of river Ndarugu in Juja Kiambu County, Kenya. The study capture people perception on the impacts of quarrying to society and environment, quarry rehabilitation methods and post quarry use of land.

2.0 Materials and Methods

2.1 Study Area Description

The study area was located in Juja in Kiambu County, Kenya; 36 km north east of Nairobi between longitude 36.999E, 37.087428E and latitude 1.06683S, 1.121300S. Juja has a population of 117, 138 according to the KNBS(KNBS 2013) with a density of 652.04 persons/km² according Kenya open data survey(Ngure et al. 2015).The main economic activities of the study area that is around the Ndarugu river are small scale farming and quarrying. Most of the farmers occupy land areas that were initially coffee plantation. The area has two rainy seasons; the long rains experienced between March and May while the short rains experienced between October and November. The area has a layer of soft volcanic rock that is easy to shape into a brick and is close to the surface thus providing a conducive environment for quarrying.

2.2 Research Design

2.2.1 Target Population and Sampling

The survey targeted homesteads of quarry owners along the ridge of river Ndarugu where they are concentrated. The population included those who had quarried land or those who aspire to rent out their land for purpose of quarrying in the near future. The population sample were selected along a transect that was parallel to the river ridge where quarried land owners are highly concentrated.

2.2.2 Data Collection

The data on perception of quarry land owners on quarrying activities and post quarry land use was collected between February and May 2015 using a semi structure questionnaire. The semi-structured questionnaire schedule addressed issues of quarrying impact, post quarried land use preference, expected benefits of rehabilitation and limiting factors for rehabilitation. The questionnaire underwent a pilot test before the actual survey was conducted. The questionnaires were issued to every other homestead along a selected transect that was parallel to the river valley to maximize the number of the respondent.

2.2.3 Data Analysis

The data collected was analyzed by statistical package for social sciences version 21. Descriptive statistics and cross tabulation were the main analysis that were undertaken. Chi square analysis was also done to evaluate statistical relationship between the different dependent and independent factors.

3.0 Results and Discussion

3.1 Profile of Land Owners

During the survey a total of nineteen homesteads were issued with the semi-structured questionnaire. 57.9% of the homesteads surveyed had between one and two households while the rest having greater than three. Majority of the households (36.8%) had more than nine family members with only 31.6% having less than three family members. 47.4% of the respondents were male while 52.6% were female. 52.6% of the respondents had age above 65 years, 10.5% between

56 and 65, 31.6% between 36 and 55, while 5.3% of the respondent were between 26 to 35 years (figure 2). This shows that majority of the land owners in the study area are old generation. 68.4% of the respondents reached primary level of education, 26.3% reached secondary school while 5.3% reached college level. Majority of the respondent (52.6%) get a monthly salary of less than Ksh10,000, 31.6% get between ten and thirty thousand while 15.8% of the respondents gets between thirty and fifty thousand shillings.

3.2 Occupation and Land Ownership

The area residents had different occupation; majority of the respondent (63.2%) were small scale farmers thus depended on farming for livelihood (Figure 3). 68.4% of the pieces of land were family owned, only 31.6% was privately owned and there was no community owned land occupied by any respondent. 94.7% of the respondents had quarried section of their land while 5.3 % quarrying on their land was yet to start.

3.3 Quarrying Activities and its Impacts on Livelihood and Environment

From the survey, 89.5% of the respondents revealed that quarries occupied more than 25% of their land (figure 4). 31.6% of the quarried land was abandoned without backfilling, 31.6% of the quarry land was back-filled without levelling, 21.1% still being quarried while 5.3% were backfilled levelled (figure 5). This reveals how quarried land have been neglected and not yielding any economic benefits.

The most perceived positive impact of quarrying were increase in household income, job creation, opening up the interiors for commercial activities and increased social harmony while the least perceived positive impact were better access to social services and better social harmony (figure 6) . This revealed that the quarrying activities along the study area benefited the locals to some extent. The quarrying activities in the areas was also perceived to have detrimental impact to the society and the environment. The most significant negative impact identified were water pollution, air pollution, poverty and noise pollution while health and safety hazard and insecurity were identified to be the least significant negative impact (figure 7).

3.4 Perception on Preference for Post-quarry Land Use

Crop farming, tree planting, dairy farming and fishing were the most preferred post quarried land use while minimal intervention for natural colonization and hotel development were the least post quarried and use (figure 9). As most of the quarried land don't yield economic benefit after quarry ceases, most of the respondent prefers more economical use of the quarried land. This demands for a cost effect rehabilitation of the quarried land for effective post quarrying land use.

3.5 Perception on Quarry Rehabilitation and the Limitation Faced

Most of the respondent strongly agreed that rehabilitation will increase income, reduce health and safety risk resulting from quarrying, create job opportunities, restore lost biodiversity and improve the productivity of the quarried land (figure 10). The result shows that most of the respondent are willing to rehabilitate their quarried land to achieve the benefits of the rehabilitation. It also shows that most of the people in the area are well informed on issues related to quarried land rehabilitation.

Most of the quarried land area along river Ndarugu has not yet been effectively rehabilitated. Lack of financial support and failure of the rehabilitating party undertaking are the most strongly agreed limiting factors to rehabilitation. Lack of technical support and regulation of rehabilitation not fully adhered to, was mostly disagreed

as rehabilitation limiting factors (Figure 11). 40% of age group of 36-55, 50 % of 56-65 and 33% of >65years group strongly agreed that poor health is a limiting factor to Quarry rehabilitation. The chi value of comparison between age and body health was found to be 4.904 and a p-value of 0.768. The p value being greater than the critical threshold of 0.05 shows there is no statistical significant between age and body health. There was no significant relationship between age and lack of technical support as well as with lack of financial support (Table 1).

4.0 Conclusion

63.2% of landowners in Ndarugu depended on farming for livelihood. Increase in household income was the most perceived positive impact while water pollution was the most perceived negative impact of quarrying to the social economic status of people living around quarrying area along river Ndarugu in Kiambu County. 31.6% of the quarried land were found to be abandoned and don't yield any economic value at the moment. Majority of the quarry Land owners are willing to rehabilitate their quarried land except that they are faced with limiting factors such as lack of financial support (94.7%). crop farming , tree planting and dairy farming were the most preferred post quarried land use for economic gain. From the study, it's recommended a well-structured quarry rehabilitation plan to be put in place for each quarry to overcome the negative impact of quarrying activities. Regulation on quarry rehabilitation and environmental conservation should be adhered to ensure quarry rehabilitation is achieve and quarry owners are able to have an economic beneficial post quarried land use. Cost effective quarry rehabilitation that is affordable by the quarry owners to be formulated to enhance rehabilitation in the study area.

References

- Bamgbose, T.O. et al., 2014. Challenges of quarry activities among rural dwellers in Odeda local government area of Ogun state. *Research Journal of Agriculture and Environmental Management*, 3(1), pp.49–55.
- Chatterjee, N., 2010. The basalt stone quarries of eastern India The basalt stone quarries of eastern India. *International Journal of Environmental Studies*, 67(3), pp.439–457.
- Chigonda, T., 2010. An assessment of the benefits and costs of black granite quarrying in Mutoko district,Zimbambwe: A socio-cultural, biophysical and economic approach. *journal of sustainable development in africa*, 12(3), pp.324–337.
- Dal Sasso, P., Ottolino, M.A. & Caliandro, L.P., 2012. Identification of quarries rehabilitation scenarios: a case study within the metropolitan area of Bari (Italy). *Environmental management*, 49(6), pp.1174–1191.
- Dong-dong, Z., Yu-shan, S. & Le, L., 2009. Study on sustainable landscape design of abandoned quarries. *Procedia Earth and Planetary Science*, 1(1), pp.1107–1113. Available at:
- Jim, C.Y., 2001. Ecological and Landscape Rehabilitation of a Quarry Site in Hong Kong. *Restoration Ecology*, 9(1), pp.85–94.
- Kaliampakos, D.C. & Mavrikos, A.A., 2006. Introducing a new aspect in marble quarry rehabilitation in Greece. *Environmental Geology*, 50, pp.353–359.
- KNBS, 2013. *Exploring Kenya's inequality: Kiambu county*,
- Lad, R.J. & Samant, J.S., 2014. environmental and socil impacts of stone quarrying -A case study of Kolhapur district. *International journal of Current Research*, 6(3), pp.5664–5669.
- Mendes, I. et al., 2014. The Social Value of Mine Rehabilitation Programs for Miner Industrial Tourism : a Contingent Valuation Empirical Application 1. In *The Welfare state in portugal in the age of Qusterity conference 9th/10th May 2014,Lisboa,Portugal*. pp. 1–25.
- Milgrom, T., 2008. Environmental aspects of rehabilitating abandoned quarries: Israel as a case study. *Landscape and Urban Planning*, 87(3), pp.172–179. Available at:
- Nartey, V.K., Nanor, J.N. & Klake, R.K., 2012. Effects of Quarry Activities on Some Selected Communities in the Lower Manya Krobo District of the Eastern Region of Ghana. *Atmospheric and climatic Science*, 2, pp.362–372.
- Ngure, J.N., Kihoro, J.M. & Waititu, A., 2015. Principal Component and Principal Axis Factoring of Factors Associated with High Population in Urban Areas : A Case Study of Juja and Thika , Kenya. *American journal of Theoretical and applied statistics*, 4(4), pp.258–263.
- Rushworth, J. & Budnik, B., 2012. Quarry Rehabilitation and Biodiversity. In *WHC Symposium 7th & 8th november 2012*. pp. 1–22.
- Weston, J. et al., 1999. More Than Local Impacts: Aggregate Quarrying in the National Parks of England and Wales. *Journal of Environmental Assessment Policy and Management*, 01(02), pp.245–268.

Table 1: comparison of rehabilitation limiting factors across Gender

limitation to rehabilitation	Pearson Chi-square		
	value	df	Asymp.sig (2-sided)
Poor body health	5.841	4	0.211
Lack of technical support	2.096	2	0.351
Lack of financial support	3.958	2	0.138
Insufficient following of law and regulations	4.293	4	0.368
responsible rehabilitating party not doing its part	4.293	4	0.368

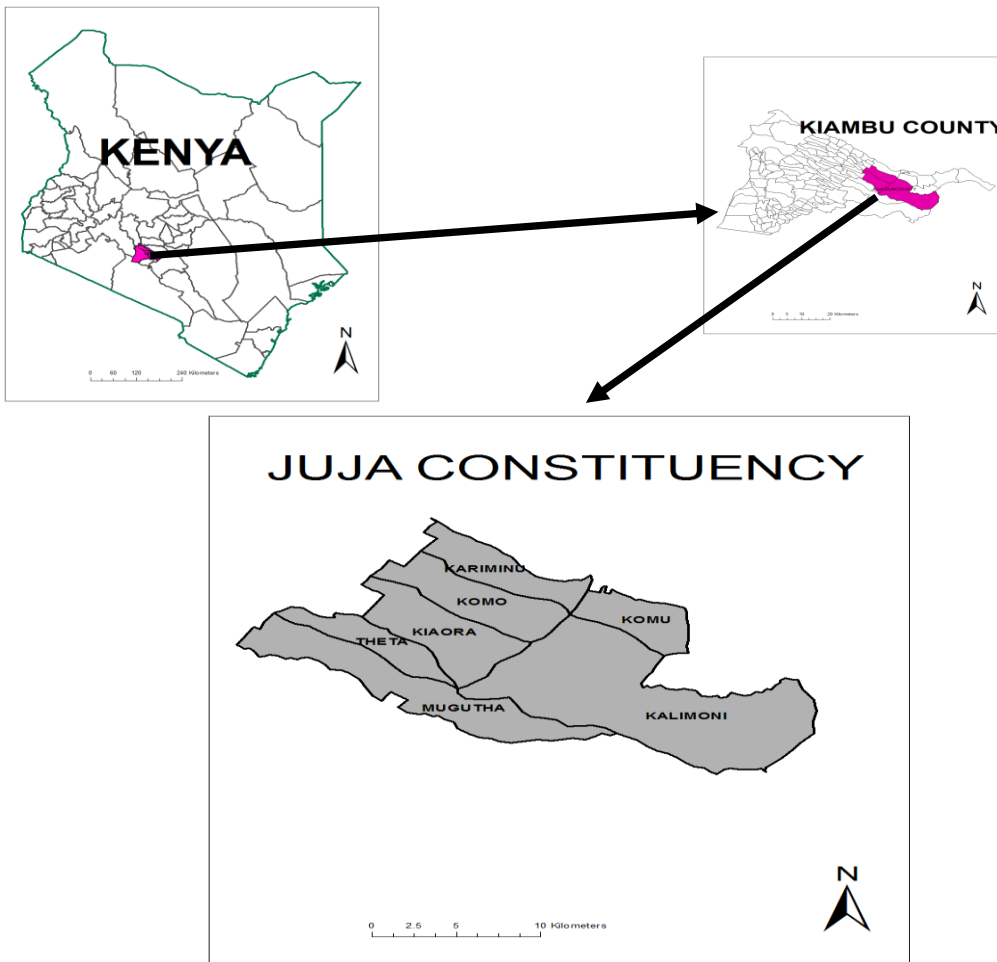


Figure 1: Study area: The map extraction of Juja Sub County in Kiambu County

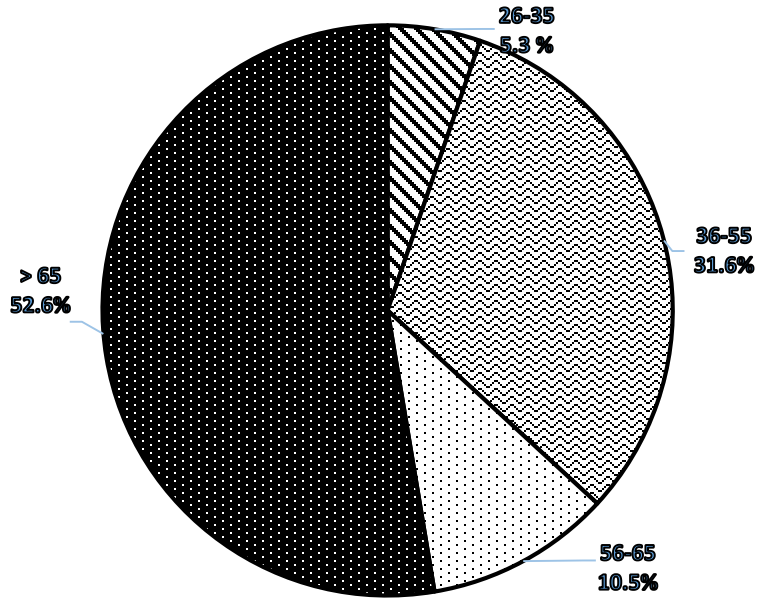


Figure 2. The chart shows the age group frequency of the Ndarugu area (n=19)

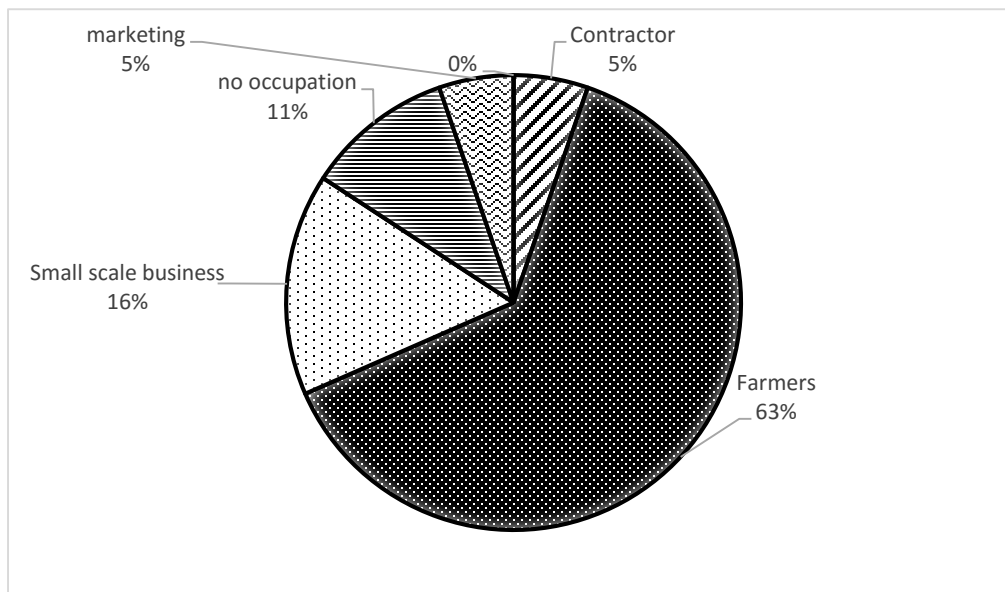


Figure 3: Primary occupation of quarry owners along river Ndarugu, Kiambu county (n=19)

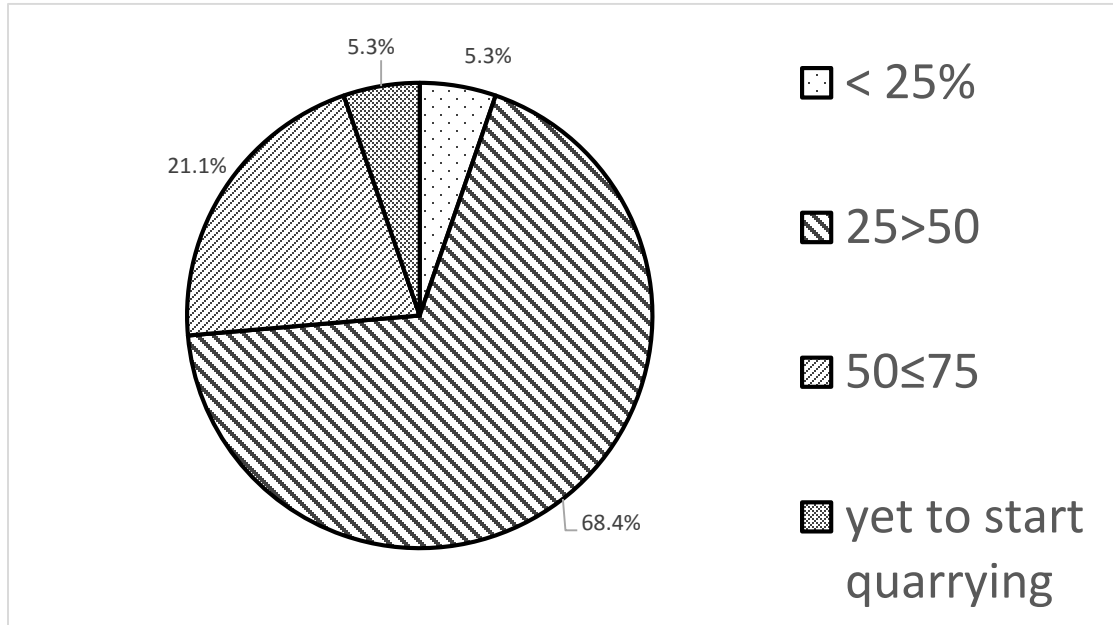


Figure 4: The proportion of land under quarrying for land owners along river Ndarugu (n=19)

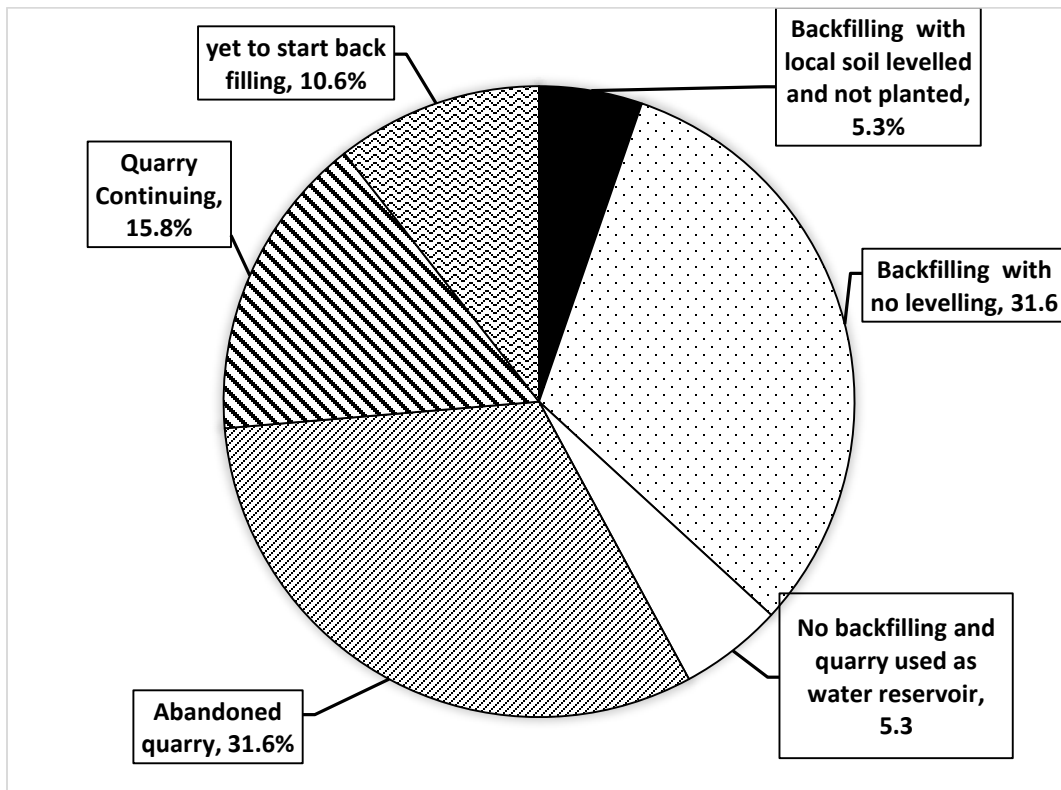


Figure 5: The current state of the quarried land of the people along river Ndarugu (n=18)

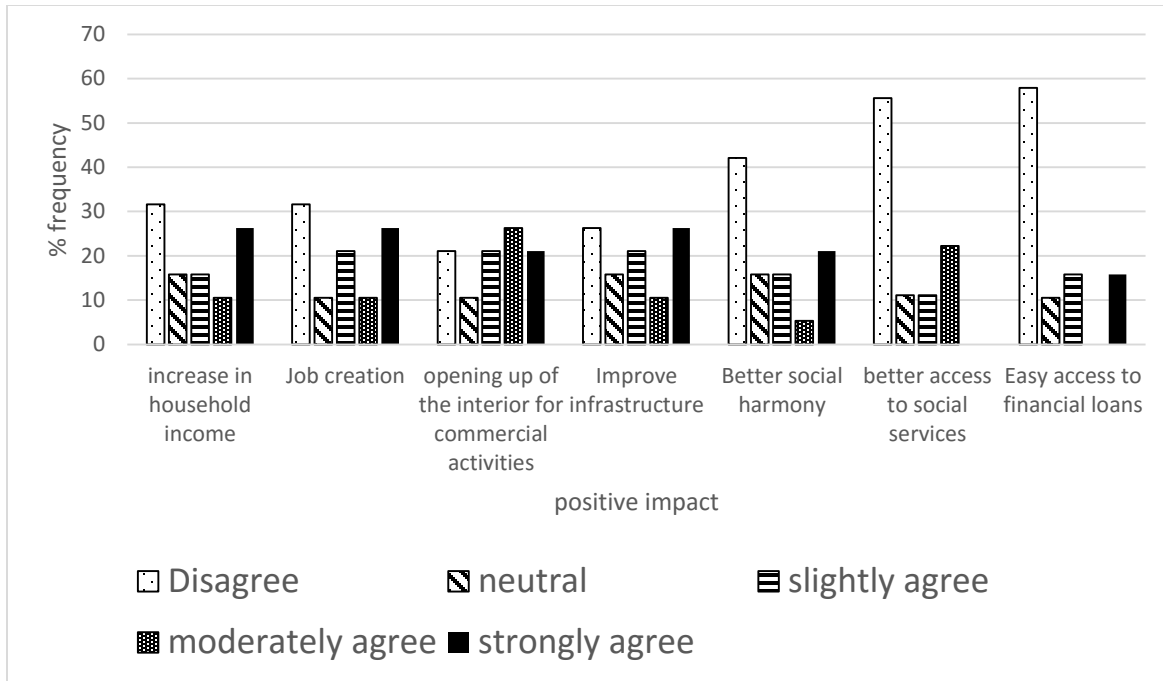


Figure 6: Positive quarrying impact on the social economy of the people of Ndarugu area, Kiambu county (n=19)

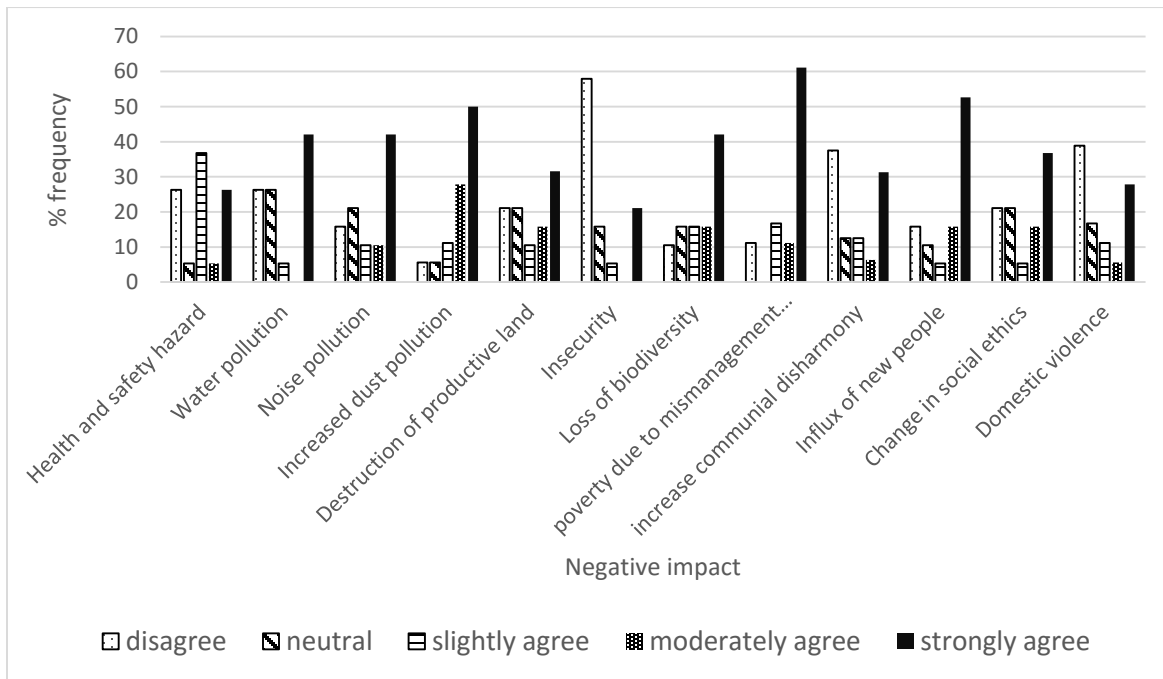


Figure 7: Negative impact of quarrying activities on the social economy of people of Ndarugu (n=19)



Figure 8: The picture shows the proximity of a homestead to an abandoned quarry that is not protected. The picture was taken during the survey

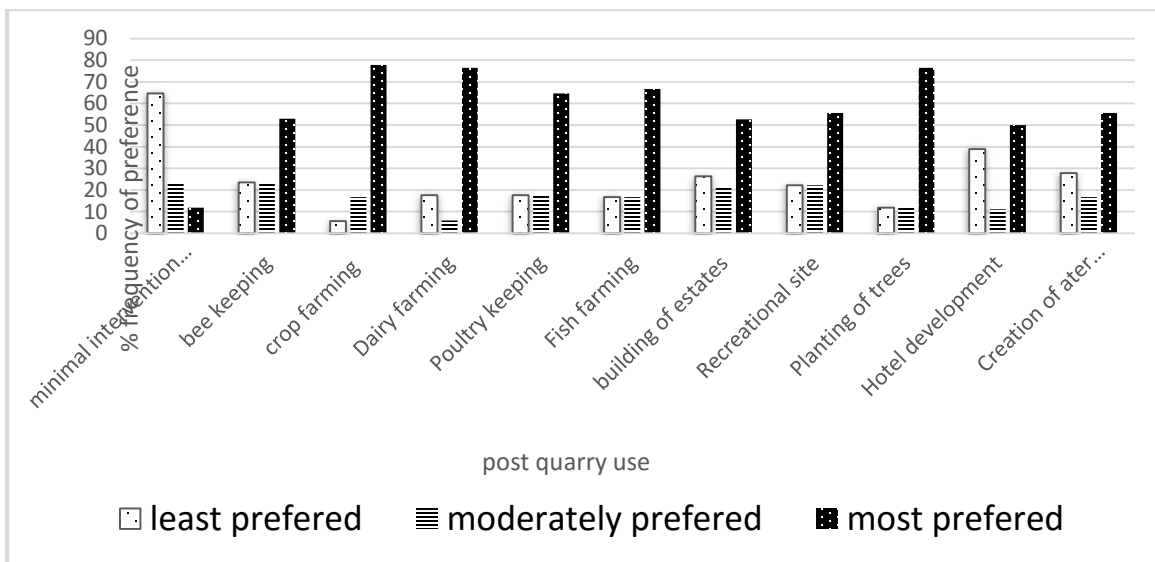


Figure 9: The graph shows the degree of post quarry use preference of people along river Ndarugu ridge

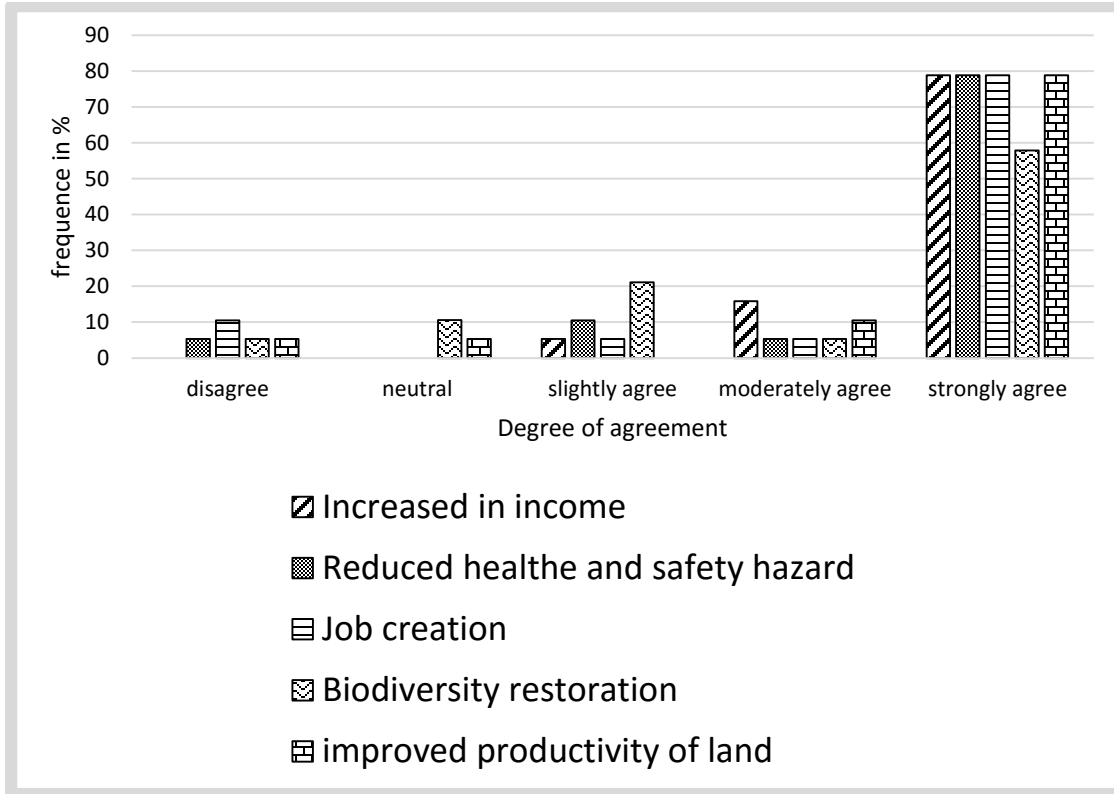


Figure 10: The degree of agreement for the perceived benefit of rehabilitation of quarries (n=19)

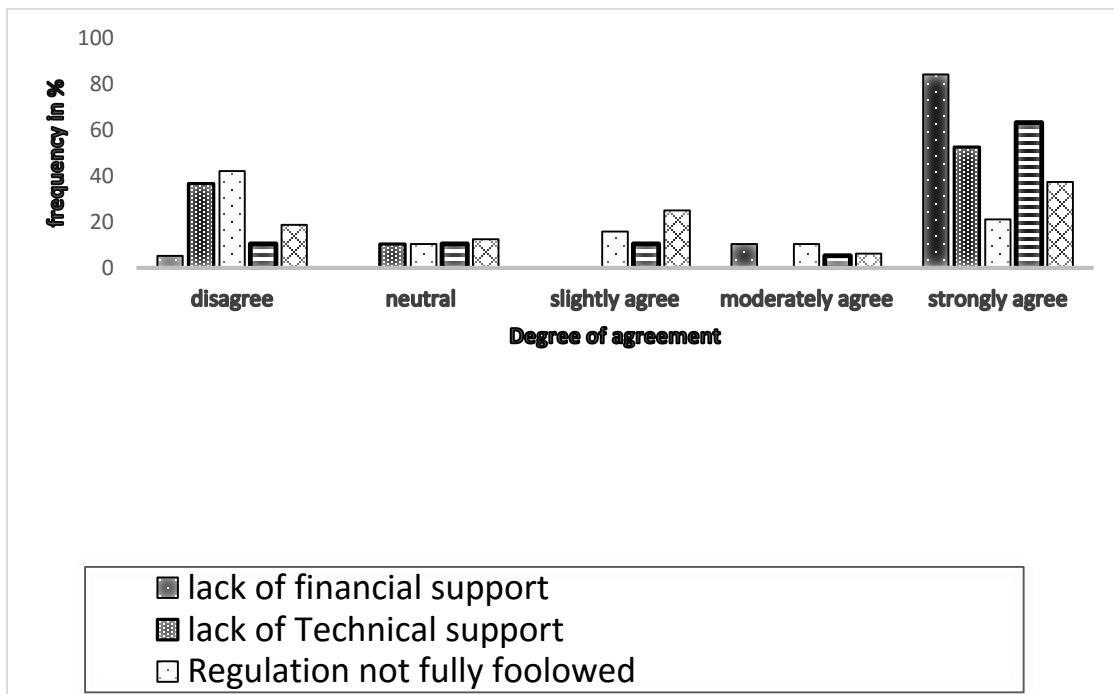


Figure 11: The graph shows the degree of agreement on the limiting factors that hinders rehabilitation of quarrying along river Ndarugu. (n=19)