

Challenges of Addressing Environmental Problems due to Quarrying Operation in Uwandani Ward, Pemba

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Abstract

This paper examines the challenges of addressing environmental challenges arising from aggregates quarrying at Uwandani Ward in Pemba, Zanzibar. Specifically, the study examines i) the socio-economic importance of quarrying, ii) the environmental impacts, iii) the interventions done to address environmental problems, and iv) the constraints over interventions. Data collection methods included household questionnaire survey, key informants interviews and participant observations. Statistical Package for Social Sciences (SPSS) and content analysis techniques were used in the analysis and processing of quantitative and qualitative data. The findings showed that although the revenue generated from quarrying operation is crucial for the livelihood of the local people, persistent environmental problems have been difficult to address due to lack of education, poverty, rapid increase of quarrying operations, drought and climate change variability, apathy in the community and inferior technology used in the quarrying operations. Furthermore, the challenges of tackling environmental problems are contributed by unsuccessful piecemeal interventions of the government because of the lack of clear recognition and appreciation of the artisanal quarrying operation contribution in the livelihood of local people. This paper recommends that the government recognizes and appreciates informal quarrying operations in order to put effective policies to develop the sector and address its environmental problems. This should be accompanied by the participation of all stakeholders in planning and implementation to address environmental problems through bottom-up approaches.

Keywords

quarrying operation, environmental problems, Uwandani Ward, Pemba

1. Introduction

Rapid growth of construction activity to meet the modern day requirements of increasing population and housing and infrastructure development needs of the society, has immensely boosted the demand for building, thus stimulating stone quarrying operations (Lad & Samant, 2014). In the developing countries where poverty levels are higher, small scale informal quarrying has become a significant source of livelihood due to little potential of the formal sector to create jobs (Ibrahim, 2007). In

Malaysia the majority of poor people depend on quarry operations as the only alternative form of livelihood (Asante et al., 2014). In Kenya, poor people both rural and urban dwellers, depend on day-to-day gathering and breaking of stones for sale (Wells, 2000). However, rock quarrying and stone crushing is now a global phenomenon and has been the cause of concern everywhere in the world, including the advanced countries (Lameed & Ayodele, 2010). Quarrying negatively affects the environment in a variety of ways from exploration and blasting, transport and disposal of waste rocks. The major environmental effects are destruction of vegetation, disruption of animal habitats, diversion and blockage of natural drainage systems, soil erosion and river siltation, noise and vibration and dust pollution (Maponga & Munyanduri, 2001). In Tanzania the mining and quarrying sector accounted for 3.3% GDP in 2013, providing 2.6% employment opportunity of the total worker employed in mining and quarrying industry (URT, 2013). In Zanzibar, the demand for aggregates in the island of Unguja has increased as a result of increased construction activities for land reclamation at Malindi harbour and reshaping the historical city's Zanzibar stone town. As for the Island of Pemba, the demand for stone aggregates has been triggered by increased building construction, decoration and pottery (Hamadi, 2005). This demand has triggered opening up of quarrying operation in many places in Zanzibar. One of these being Uwandani ward in Pemba where the quarrying operation has led to sustained environmental impact to the environment (Backsdale, 2013). It is widely argued that environmental problems in places where quarrying is carried out arise due to poor or inadequate legislation and enforcement with resultant lack of efforts in monitoring, rehabilitation, restoration or post-mining programmes for minimization of adverse environmental impacts (Lad & Samant, 2014).

The Revolutionary Government of Zanzibar has made several interventions in protecting the environment through different policies such as the Environmental Policy (2013), the Education Policy (2006) and the Water Policy (2004). Furthermore, the Government of Zanzibar formulated the Strategy for Growth and Reduction of Poverty (ZSGRP) to stem out environmental problems (GoZ, 2010). Yet, most environmental problems, including those arising from quarry operations have been difficult to solve (Backsdale, 2013). The objective of this paper is to examine the challenges of tackling the tacking environmental problems arising from quarrying operations in Uwandani Ward in the island of Pemba, Zanzibar. Specifically, this paper examines i) the socio-economic importance of quarrying operation, ii) the environmental impacts of quarrying operations, iii) the interventions by the local communities to tackle environmental problems, iv) the constraints that inhibit efforts to tackle environmental problems arising from quarrying operations.

2. Study Area

The study was carried out at Uwandani Ward/Shehia which is administratively in Chake-chake District in South Region Pemba, Zanzibar. Zanzibar is a part of the United Republic of Tanzania. It consists of two major sister islands—Unguja and Pemba which are situated in the Indian Ocean, approximately 35

km off the mainland of Tanzania at 7° and 9° at 6° South of the Equator and about at 39° E. The Island of Pemba lies about 40 km North East of Unguja Island with a surface area of 988 km^2 (Kombo & Kanyama, 2015). In Zanzibar, the demand for aggregates in the islands of Unguja and Pemba has increased dramatically over the recent past due to increased construction activities. Uwandani Ward in Pemba is endowed with informal quarrying operations which affect the environment negatively (Backsdale, 2013). This study was specifically conducted in seven villages of Uwandani Ward, namely, Uwandani, Mjananza, Pande Mkwajuni, Mibungoni, Musharifu, Makaani and Gongoni. These villages are located near the quarrying sites of Uwandani, about 1 kilometre. According to Nartel et al. (2012), the impact of quarrying operations can be studied well in the communities within 1 km from the operations.

3. Methodology

Data collection methods included household questionnaire survey, key informants interviews and participant observations. Questionnaires and interviews were used to obtain both qualitative and quantitative data. Quantitative data was obtained from household survey while qualitative data was obtained from direct observation and key informant interviews. Secondary data was obtained from published books and reports, unpublished reports, journals and web sites. Of the total 245 households in Uwandani Ward, 71 households were involved in questionnaire survey in the seven villages interviewed. The sample size was obtained using the formula below (Yamane, 1967):

$$n = \frac{N}{1 + N(e^2)}$$

The distribution of households' respondents in village appears as shown in Table 1 below:

Table 1. Distribution of Household Respondents in Each Village

Village	Uwandani	Mjananza	Pande	Mibungoni	Musharifu	Makaani	Gongoni	Total
H. Sample	12	10	10	8	10	11	10	71
Percent (%)	17	14	14	11.5	14	15.5	14	100

Interviews were conducted with 11 key informants involving 7 Village Executive Officers, 1 District Environmental Officer, 1 District Land Officer and 1 Leader of Uwandani Environmental committee (Table 2). The data from interviews and key informants supplemented the data obtained from questionnaires. Observation was carried out to complement other methods such as questionnaires and interviews. Transect walk was carried in the quarry sites with the leader of Uwandani environmental quarrying committee, showing how quarrying activity is done in the ward. Through transect walk, it was possible to observe and records relevant information concerning the environmental condition due

to quarrying operation in the study area. Statistical Package for Social Sciences (SPSS version 16.0) tool was used to compute the mean, display frequency distribution and percentage and for drawing histograms. Cross tabulation was used to obtain the relationship between variables and qualitative data was analysed using structural-functional and content analysis.

Table 2. Distribution of Key Informant

Title	DEO	DQO	DLO	LUEQC	VEO	Total
No. of key informant	1	1	1	1	7	11
Percentage (%)	9.1	9.1	9.1	9.1	63.6	100

Note. DEO—District Environmental Officer, DQO—District Quarrying Officer, DLO—District Land Officer, LUEQC—Leader of Uwandani Environmental Quarrying Committee, VEO—Village Executive Officer.

4. Results

This section presents the results of four main areas of inquiry for this study, concerning quarrying operation in Uwandani Ward namely, i) the socio-economic importance of quarrying operation, ii) specific environmental impacts of quarrying operations, iii) interventions done to address environmental problems resulting from quarrying operations, and iv) constraints inhibiting the tackling of environmental problems arising from quarrying operations.

4.1 Level of Education and Occupation Characteristic of Respondents

The results on education (Table 3 below) show that 70% of the respondents in the study, had never attended school or had primary education only. A few of them reached secondary school level, i.e., 21.1%, while 5.6% and 2.8% had acquired certificate and diploma education respectively.

Table 3. Education Level of Respondents

Level of Education	Frequency	Percent
Not attended school	10	14.1
Primary education	40	56.3
Secondary education	15	21.1
Certificate	4	5.6
Diploma	2	2.8
Total	71	100.0

Sources: Field Data, March 2015.

Concerning occupation, the majority of the respondents were engaged in quarrying operations, i.e., 40.8%. Another main occupation in Uwandani Ward was farming, engaging 28% of the respondents

(see Table 4).

Table 4. Occupations of Respondents

Occupation	Frequency	Percent
House wife	5	7.0
Grocery and shop owners	5	7.0
Quarrying	29	40.8
Bricks seller	8	11.3
Farmer	20	28.2
Teacher	3	4.2
Doctor	1	1.4
Total	71	100.0

Sources: Field Data, March 2015.

The results show that all respondents who were engaged in quarrying operation (see Table 4) felt that they benefited from the quarrying operation. The proportion of the livelihoods aspects (29%) respondents that felt were fulfilled by the revenue generated from quarrying were significant for food (82%), clothes (58%) and health services (34%). Other aspects of livelihoods which were felt to be fulfilled less by revenue generated from quarry operation were the cost of education (17%) and shelter (17%) (see Table 5).

Table 5. Benefits from Quarrying Operation

Benefit from quarrying operation	Frequency (n=29)	Percentage (%)
Education	5	17
Health Services	10	34
Shelter	5	17
Clothes	17	58
Food	24	82

Source: Field data Survey, 2015.

Note. Data, based on multiple responses, n=Sample size.

4.2 The Impact of Quarrying Operations on the Environment

The results show that 77% of the interviewed respondents felt that quarrying operations had negative effects on the environment while 23% had no knowledge whether quarrying operation had effect on the environment (see Table 6).

Table 6. Household's Perceptions on the Effect of Quarrying on the Environment

Villages	Responses (%)			
	Yes has environmental effect	%	Do not know	%
Respondents (n=71)	55	77	16	23

Source: Field survey data, 2015.

The effects of quarrying operation on the environment perceived by the respondents who acknowledged the existence of environmental effects were soil degradation, human health, water pollution, air and noise pollution, deforestation, pit formation and formation of informal routes (see Table 7).

Table 7. Effects of Quarrying Operation on the Environment-Household's Perception

Variable measures	Frequency (n=55)	Percentage (%)
Soil degradation	40	72
Water pollution	20	36
Air pollution	50	90
Noise pollution	20	36
Habitat disruption	15	27
Human Health	20	36
Deforestation	20	36
pit formation	50	90
Waste generation	40	72

Source: Field data Survey, 2015.

Note. Data based on multiple responses, n=Sample size.

On whether the community responds to minimize the environment problems caused by quarrying operations, 73% of the 55 respondents felt that there was no meaningful response while 27% felt that there was adequate response (see Table 8).

Table 8. Community Response to Environment Effects due to Quarrying Operation

Responses categories	Frequency	Percentage (%)
No	40	73
Yes	15	27
Total	55	100

Sources: Field Data, March 2015.

The results show that community responses to environmental effects resulting from quarrying operations as felt by 15 respondents were rehabilitation of land by land fill, reforestation and abandoning quarrying activities by switching to other activities such as fishing and agriculture (see Table 9).

Table 9. Local Community Response to Environmental Effects due to Quarrying Operations

Variable measures	Frequency (n=15)	Percentage (%)
Land rehabilitation/land fill	7	47
Reforestation/planting trees	5	33
Abandoning quarrying operation	2	13
Relocating to other living areas	2	13

Source: Field data Survey, 2015.

Note. Data based on multiple.

4.3 The Constraints of to Address Environmental Challenges

A few respondents felt that local community intervened in tackling environmental problems arising out of quarrying (see Table 9). On the whole, all the 55 respondents who thought that quarrying lead to environment destruction, felt that the local community face challenges in addressing the problems. These challenges include i) lack of education on the effect of quarrying operation on the environment, ii) lack of financial support from the government in stemming environment destruction due to quarrying operations and inadequate technical support in, e.g., assessment and evaluation of quarrying operations, iii) rapid increase of quarrying operations overwhelms efforts to tackle environmental problems, iv) drought and climate change compel many people to engage in quarrying operations instead of farming, v) poverty accompanied by the lack of motivation and willingness among the local communities to engage in addressing actions to stem environmental problems due to quarrying operations, and vi) inferior technology used in the quarrying operations (see Table 10).

Table 10. Challenges of the Local Community in Tackling Environmental Problems from Quarrying Operations

Variable measures	Frequency (n=55)	Percentage (%)
Lack of formal/Environmental education	40	72
Lack of support from the government in assessment and evaluation/financial support	20	36
Rapid increase of quarrying operation	20	36
Climatic change and variability	20	36

Poverty/Apathy-Lack of community willingness to address environmental problems	15	27
Inferior technology used in quarrying operation	25	45

Source: Field data Survey, 2015.

Note. Data based on multiple responses, n=Sample size.

Key informants felt that the challenge facing in tackling environmental problems arising from quarrying operations in Uwandani Ward comprised of, i) lack of support from local people, ii) Poverty, iii) poor inter-sectoral coordination, iv) poor governance, and v) poor knowledge on in the communities on how to tackle environmental problems due to quarrying operation (see Table 11).

Table 11. Government Challenges to Address Quarrying Environmental Problems

Responses	Frequency (n=11)	Percentage (%)
Lack of support from local people	7	64
Drought and climate change	8	72
Poor inter-sectoral coordination	6	54
Poor government financial and technical support	8	72
Low education of the communities	6	54

Source: Field data Survey, 2015.

Note. Data based on multiple responses, n=Sample size.

5. Discussion

The results in this study, have shown that the majority, i.e., about 41%, of the respondents in the villages of Uwandani Ward depend on quarrying operations for their livelihoods (see Table 4). Income earned from engagement in quarrying operations was useful to meet the costs for children education, health services, shelter, clothes and food needs (see Table 5). Stone quarrying in Pemba is predominantly operated in an informal manner as a strategy for survival for poor people, mostly with low education (Backsdale, 2013). As shown in Table 3, the majority of the respondents, i.e., 70%, in Uwandani Ward had only attended primary school or not attended school at all. One of the respondents said, *"I have no education that can enable me to be employed anywhere else. So, I rather crack stones to support my family"*. Likewise, drought and climate change variability was seen by the respondents as a cause for entering into quarrying operations due to reduced yield in subsistence agriculture (see Table 10). Similarly, the District Environment Officer stressed that most people in Uwandani Ward were engaged in quarrying operations because persistent drought and climate change and variability have led to successive reduced agriculture yields necessary for livelihoods support. Empirical Studies have shown clearly that, like other parts of Tanzania, climate change and variability has occurred in Zanzibar

in the form of temperature and rainfall variability (Kombo & Kanyama, 2014). Looking at this, from African perspective in general, Wells (2000) observes that climate change and variability has pushed many people in rural Africa to non-farm informal activities such as quarrying due to the continuous decline in farm yields. Ibrahim (2007), observes that the informal sector in Africa, e.g., quarrying operations, has become an attractive alternative for achieving livelihoods needs because the formal sectors has very little potential in terms of job creation. McCandless (2013), argues that the necessity of quarrying is undeniable as millions of people worldwide are employed by quarrying practices and, therefore, removal of the quarrying industry would result in the loss of jobs for countless families. In Tanzania, artisanal mining/quarrying provided 500,000 informal employment and 1,780 formal employment by 1997 (Kabwe, 2008).

However, although quarrying activities are a necessity as a means of livelihoods support and provide much of the materials used in the construction industry, they cause significant impacts on the environment (Okafor, 2006). These include destruction of vegetation, disruption of animal habitats, diversion and blockage of natural drainage systems, soil erosion and river siltation, noise and vibration, dust pollution and disposal of waste rock (Lad & Samant, 2014). The results in this study show that the majority of the respondents, i.e., 77% of the 71 respondents, felt that quarrying operations had negative impacts on the environment (see Table 6). The respondents mentioned environmental problems caused by quarrying as soil degradation, human health, water, air and noise pollution, deforestation, habitat disruption, pit formation and formation of informal routes (see Table 7). Likewise, field observation showed significant impacts at the quarrying sites where soils, debris and dust were compacted and land cleared with deep barrow pits (<7m deep) which impaired other land uses, e.g., settlement, agriculture and animal rearing. Interview with the leader of Uwandani environmental quarrying committee showed that deep pits led to loss of biodiversity, risks of accidents and were breeding sites for mosquitoes. In addition, the leader of Uwandani quarrying environment committee stressed that cleared land had been a sources of conflicts between quarry operators, farmers and livestock keepers. Furthermore, interview with the District Environmental Officer showed that there has been an increase in diseases caused by quarrying operations. According to Kitula (2005), common diseases along the quarrying sites included airborne dust, water bone diseases and infectious diseases.

Regardless of the environmental and health impacts associated with the quarry operations, the majority of the respondents (73%) thought that their local community was not doing much to redress the situation (see Table 8). The respondents pointed out a number of constraints which inhibited local people from mitigating the environmental effects from quarrying namely, i) lack of education on Environmental conservation, ii) lack of support from the government in assessment and evaluation, iii) inadequate government financial support to tackle environmental problems, iv) rapid increase of quarrying operation, v) climate change and variability, vi) lack of community willingness on to tackle environmental problem, vii) poor technology used in quarrying operation (see Table 10). These

concerns were also felt by the key informants. The District Environmental Officer felt that illiteracy and low education level (see also Table 3) among the people of Uwandani ward contributed to apathy in conserving the environment at the quarrying sites. He acknowledged that the government was not active in assessing or evaluating the environmental impacts of quarrying operations. This has contributed to increased accumulation of hazardous wastes at the quarry sites. Furthermore, the leader of Uwandani quarrying environmental committee suggested that the government should extend adequate financial support to address the environmental effect at Uwandani quarrying sites. The Village Executive Officers indicated that the efforts to tackle the environmental problems were overwhelmed by the rapid pace of the increase of quarry operations because people were entering into the operation due to the failure of agriculture, because of recurring droughts and climate change variability.

According to the leader of Uwandani quarrying environmental committee, the inferior nature of the tools used in quarrying operations constrains the prospects to tackle environmental problems since people are exposed to a harsh environment for a long period to produce enough stock of quarry for sale. The tools that are commonly used include hammers for cracking and crushing rocks, chisel for widening cracks in the rocks, metal rods for cracking rocks in between soil layers and plastic buckets for measuring and lifting extracted rock materials from one place to another. One respondent observed that: *“extracting rock stone from the ground is not a simple job, it needs a lot of energy and time because the tools we use are not good”*.

On the whole, according to Village Executive officers, the improvement of the environment is hampered by the socio-economic and cultural factors which include poverty, ethics, level of education and illiteracy and how people obey environmental regulations and laws. Uglow (1999), observes that in developing countries, quarries operate as a complex process where responsibilities and authority are not easily defined. With little regulatory enforcement, there is little pressure on small-scale quarry operators to preserve the environment and refrain from blasting, replacing top soil, or to replant trees.

Quarry operation as informal activity has often been out of legal and government regulations, stigmatized as troublesome and unmanageable, yet it makes up a significant portion of economies in Africa (Wilson, 2012). In Zanzibar a number of environmental problems due to quarrying operation arise because the sector has not received the necessary attention from the government (Yusuf, 2012). The results from the interviewed key informants show that the challenges faced by the government in tackling environmental problems from quarrying include i) lack of support from the local people due to poverty, ii) drought and climate change variability which lead to poor agricultural yields, iii) poor inter-sectoral coordination, and iv) poor government support. All these difficulties to tackle environmental problems at Uwandani Ward occur against the backdrop of different policies formulated to protect the environment in Zanzibar. These included the Environment Policy (1992), Environment policy (2013), Water Policy (2004) and the Education Policy (2006). The Environmental Policy outlines the principles, regulation and laws that governs the protection of the environment, including air

and water, protection of natural resources, biodiversity, both wildlife and endangered species. The results from perceptions and observations in this study have shown that the quarrying operation pollute water bodies. Yet, the Water Policy of Zanzibar is meant to addresses cross-sectoral interests in water, watershed management, and integrated and participatory approaches for water resources planning, development and management (GoZ, 2004). The results in Tables 10 and 11 show that the local people do not have adequate knowledge on environmental problems and, therefore render poor cooperation to the authorities in addressing the environment problems resulting from quarry operation. However, the Education Policy (2006) of Zanzibar has stipulated the necessity of incorporating environmental education into the school curricula. This includes environmental management and conservation of natural resources. The policy emphasizes on strong coordination between the environmental authority and the Ministry responsible for Education to easily mainstream environmental education subjects into the school curricula and perform special long and short courses, trainings for professional staff, community members and students at different education levels (GoZ, 2006). Questionnaire responses have shown that apathy due to poverty contributed to the failure of the people to participate to curb environment problems arising from quarrying operations. However, the government of Zanzibar had formulated the poverty reduction strategy (ZSGRP) to improve the livelihoods conditions of the people (GoZ, 2010). The strategy is contained in the Vision 2020 of Zanzibar which involves conservation and protection of the environment, rational and efficient utilization of natural resources (GoZ, 2013b). The results of the study show that poor agricultural yields due to climate change and variability have exacerbated poverty among people and forcing them to engage in quarrying operations. However, future scenarios indicate that climate change is expected to intensify with associated negative impacts on the environment in Zanzibar (Agrawala, 2003). Yet, Zanzibar has no standalone policy for climate change which can coherently direct how to cope with vulnerabilities in the agriculture sector (Kombo & Kanyama, 2014). There are, however, several policies as described above, which touch flimsily and haphazardly on the issues of environment/climate change and variability. On the whole, the difficulty to tackling environmental problems, arising from quarrying operations in Uwandani Ward is due to poor implementation of policies and poor inter-sectoral coordination. Interviews with key informants showed that there was overlapping competences of different sectors in matters of environmental protection and conservation which lead to poor interventions in addressing environmental problems from quarry operation at Uwandani Ward.

6. Conclusion

This study found that quarrying operations provide employment to the majority of people in Uwandani Ward, thus becoming an important source of livelihoods support for the people. The low level of education and poor yields in agriculture due to drought and climate change variability have compelled people to engage in quarry operations. However, there are a number of environmental problems arising

from quarry operations, namely, soil degradation, human health problems, water pollution, air and noise pollution, deforestation, habitat disruption, pit formation and formation of informal routes. There are a number of constraints in ameliorating these environmental problems in Uwandani Ward. These include lack of education on Environmental conservation among the residents, lack of support from the government, rapid increase of quarrying operations, drought and climatic change and variability, apathy among community members due to poverty and poor technology used in the quarrying operations. The government of Zanzibar has policies in place. These include the Environment, Water and Education policies, all emphasizing the need to tackle the environmental problems arising from human activities. Likewise, the government formulated a strategy for poverty alleviation to lift many people from poverty in order to avoid environmental degradation that may be brought about by poverty. However, the poor implementation of the policies and strategies and inadequate sectoral coordination have contributed to the persistent increase of environmental problems in Uwandani Ward. This paper recommends that the importance of small scale stone quarrying should be appreciated and recognised in legal and government regulations. Recognising the importance of stone quarrying will help to address the needs of small stone workers and provide the necessary assistance and promote the involvement of stakeholders in addressing environmental problems.

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