

## Characterizing the Environmental Effects of the Quarrying Industry: The Case of Strategic Quarry Sites in the Ilocos Region

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### Abstract

*This study tried to identify the environmental effects of quarrying in the identified quarry sites of Region 1 chosen at random, specifically at a geologic perspective. It further tried to discover the socio-economic benefits they provided to the residents of adjacent and nearby barangays within the provinces of Ilocos Sur, Ilocos Norte, La Union, and Pangasinan; and solicited their perceptions on the pressing effect(s) of the industry.*

*Four types of quarrying were found in Ilocos Sur, namely: clay extraction at Bulala, Vigan City; gravel quarrying at Banaoang, Bantay, and at Bio Tagudin; sand quarrying at Namruangan, Cabugao and at Libtong, Tagudin; and mountain quarrying at Nalvo, Sta. Maria. The quarry sites mentioned were described to be from excessive to highly excessive.*

*In Ilocos Norte, the researchers noted three types of quarrying: clay extraction at Sta. Monica, San Nicolas; sand quarrying at Paoay; and gravel extractions at Bengcag, Barangays I and XV, Laoag City, as well as in Bacarra. Meanwhile, quarrying is banned at Bengcag, Laoag City. A shift in the original course of the San Cristobal, Sarrat River has been confirmed by the residents. They attributed the rerouted course of the river to the continuous unplanned gravel extraction therein.*

*In La Union, three quarry types were noted; gravel extraction at Sudipen and Rosario, sand extraction at Rimos 1, 2, 3, 4 and 5, Luna, La Union; and rounded pebbles. The quarry operations were assessed to be excessive.*

*In Pangasinan, the researchers noted sand and gravel extractions at Bugallon; and gravel extractions at Labrador, Anonang, San Fabian, and San Jacinto.*

*The observed physical changes or environmental effects of the quarrying operations were: a) for sand quarrying: weakened soil cohesion leading to sand dune collapse and air pollution during windy and stormy days; b) for gravel quarrying: widened mouth of the river leading to a widened downstream flow and diverted water course, c) for earth extraction: uneven ground elevation permitting water to be impounded during the rainy season, and worst, the cause of flooding for neighboring barangays; and d) for mountain quarrying: triggered land slide and thinning water reserve.*

*The mitigations were concentrated mostly on more extensive regulatory schemes: for the DENR to regulate the quarrying operations, more strict monitoring of hauling permittees, and rectification of damaged sites by environmental interventions.*

## Introduction

### Background of the Study

With nature as the foremost provider of resources, it has already been an accepted observation that the economic growth of any place lies on its resource extractive industries (Cerilles, 1999).

The Construction Industry is one type of resource extractive industry. The Construction Industry Authority of the Philippines (CIAP) report reveals that in Region 1 it is booming. Widespread construction happens around from the simplest bungalow to medium-rise establishments attesting to the validity of the CIAP report.

Consequently, a high demand for construction necessitates more volume of aggregates to be extracted from quarry sites. Gravel and sand, the most common extractive resources, are two of the most important materials in the construction industry. Gravel is categorized as coarse aggregate, while sand, is the fine aggregate. Both are materials for concreting, and are extracted along the riverbanks. Likewise, for fill or embankments, earth is used and extracted from mountains.

Such extractions alter the normal occurrences of nature. Earth hauled from mountains affects the watershed. Gravel and sand extractions widen the river banks, lower its elevation, and weaken soil cohesion.

The Philippine Mining Act of 1995 was passed to maintain the utilization of minerals as a development option, on the condition that mining shall be undertaken within sound environmental framework, consistent with the principles of sustainable development.

For aggregate quarrying, is the condition of the Philippines Mining Act complied with?

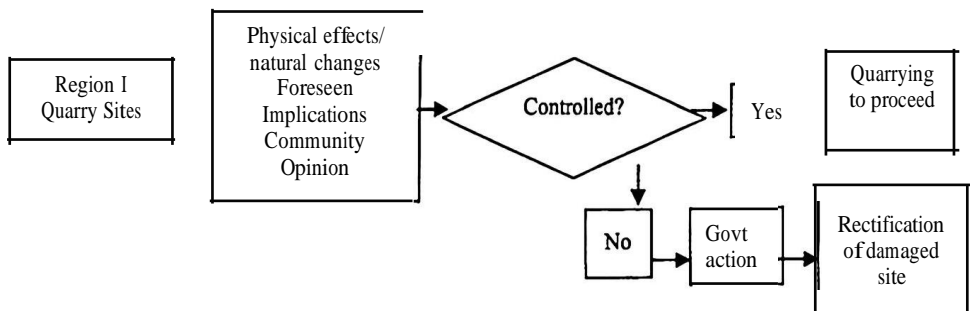
## Objectives

Generally, this research work aims to discover the effects of quarrying in Region 1, which could be gradually unveiled by the following specific objectives:

- I. What are the most popular quarry sites of Region 1 as to: sand, gravel, earth particles or other miscellaneous aggregates?
2. What are the physical effects or natural changes observed in the quarry sites?
3. How is quarrying categorized as to a) controlled or b) uncontrolled in the sites?
4. What positive and negative effects were observed among the residents living near the quarry sites?

## Conceptual Framework

This exploratory study was conducted using the scheme presented below:



*Fig. I. The Research Paradigm*

## Methodology

The study was conducted using the descriptive method of research. Data on the noted effects of erosion and flooding, etc. due to excessive hauling of aggregates were gathered and documented by taking pictures and conducting interviews thereat.

The quarry sites were chosen at random from the lists furnished by the DENR Offices from each province in Region 1, namely: Ilocos Norte, Ilocos Sur, La Union and Pangasinan.

## Review of Related Literature

In January 1999, then DENR Secretary Antonio Cerilles suspended the quarrying of sand and lahar in the provinces of Tarlac, Pampanga and Zambales, but lifted the same on March 6, 1999 in support to Proclamation 66 by then Pres. Joseph Estrada regarding the proper management of river systems and the exploitation and utilization of the sand and lahar deposits in order to maintain and improve the water flow, reduce risk to life and property and restrain in an appropriate manner mineral exploitation and land use (<http://newsflash.org/1999/03/ht0006999.htm>).

A study conducted by Danilo Israel revealed that quarrying have potentially significant negative environmental impacts. Mountain quarrying results in the scraping of the upland topsoil and vegetation and the destruction of the aesthetic value of the quarried area. For river quarrying, the noted effect was the uneven deepening of the riverbeds, and the destruction of the river banks (<http://www.pids.gov.ph>).

Another study conducted by Israel, et al in Palawan confirmed the negative environmental impacts of river quarrying. The authors found that both the quarrying firms and the households believed that they suffered the ill defects of quarrying and that quarrying operators are not doing enough to address the problems.

The government of United Kingdom adopts Forward with Leicestershire Aggregate Grants (FLAG) project which distributes funding from the Government's Aggregates Levy Sustainability Fund to schemes that reduce the effects of quarrying therein. Such a project is the granting of £21,000 to Lafarge Aggregates to plant two new woodlands of native trees at Shawell Quarry. Planting at this sand and gravel site will help to screen the quarry operations and provide a wildlife habitat. Another similar grant in the amount of £18,000 was given to Hinkley and Bosworth Borough Council for a range of environmental and access improvements at Hill Hole Quarry, a disused granite quarry (<http://www.leics.gov.uk/pressrelease.htm>).

## Results and Discussion

### Quarry Sites in Ilocos Sur

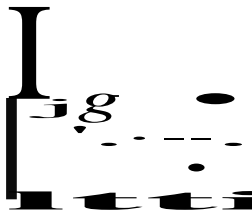


Figure 2. *Bulala, Vigan City*

Bulala, Vigan City. There is an excessive quarrying of earth clay in this quarry site. The extracted clay is used for the production of the bricks and tiles which are the primary products manufactured at the southern barangays of the Heritage City of Vigan. The continuous extraction of earth clay had negative effects which include flooding of the area where clay is hauled and of the adjacent barangays, degradation of the earth's structure; and destruction of the elevated profile of the land.

Banaoang, **Bantay**. The Banaoang River is a great source of sand, gravel and boulders. Just like Bio, Tagudin, contractors use different hauling equipment to extract the aggregates. Quarrying is continuously pennitted by the provincial government with different locations. With these, the mouth of the river is becoming wider, extending the discharge of water to cause flooding of fanlands and houses near the river banks.

The respondents claim that due to the weakened banks caused by sand and gravel extraction, about 30 to 100 meters of farmlands planted with com, and of rice fields have already been washed out. The flow of water had changed northwest, affecting the eastern barangays of Vigan: Raois, Rugsuanan, Nagsangalan, and Bongtolan, as well as Paing and Taguiporo, Bantay.

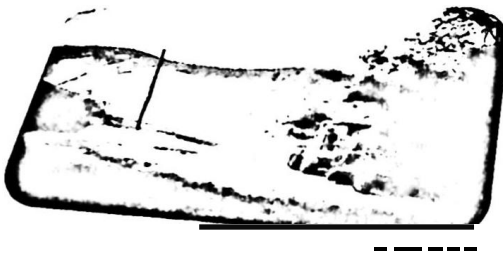


Fig. 3. *Namruangan, Cabugao, Ilocos Sur.*  
*Quarrying disturbs the serenity of sand dunes.*

**Namruangan, Cabugao.** Namruangan is a coastal barangay where sand dunes abound. Before, one has to climb up the sand dunes to see the sea. Now, the place has changed because of the continuous extraction of the sand dunes. One of the noted changes, according to the residents, is the identifiably evident river and sea connection. Now, every typhoon introduces a new route to the river. Another effect of the excavation is the

disturbed natural cohesion, especially that sand particles have generally weak coherence with each other. As a result, the disturbed surface readily dusts off even for slight wind

action. Due to rampant sand extraction, the sand dunes are slowly vanishing. They are extracted even lower than the natural ground elevation. The excavation is even extended to as low as five to eight meters deep that one pay loader could not be seen at a distance. With the deep excavation, water is impounded to pave way for fishpond situations.



Fig. 4. *Nalvo, Sta. Maria, Ilocos Sur.* Residents have protested against mountain excavation due to thinning watershed reserve.

year. Many trees were cut during the excavation. They should have provided the felt water shortage of the barangay now. Presently, the extraction was banned through the efforts of the barangay council.

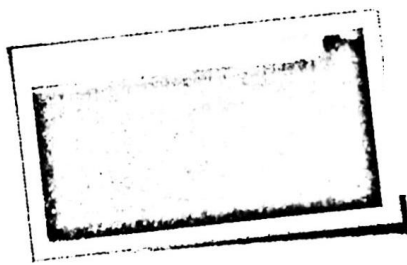


Fig. 5. *Bio, Tagudin, Ilocos Sur.* Widened river bed and eroded banks aggravated by quarrying causes flooding in nearby houses.

**Nalvo, Sta. Maria.** Before the barangay proper of Nalvo, Sta. Maria, a mountain, already standing for centuries, now gradually disappears from view after a considerable portion of its northern end facing the barangay road has been excavated to fill various embankments for purposes of meeting elevation requirements in construction. With the mountain excavation, the barangay generated income out of the taxes paid by haulers. On the contrary, the residents noticed their thinning watershed and salt intrusion during the summer months. When the mountain was not yet touched, they had sufficient drinking water for the whole

**Bio, Tagudin.** The Amburayan River flows through this quarry site. It has a huge source of aggregates, such as sand and gravel, used in construction and earth filling. About fifteen years ago, the mouth of the river as was not wide as it is now. With the continuous extraction of aggregate, there has been a voluminous amount of earth fill extracted from the place. According to the residents of Bio, Tagudin, contractors and some of the non permittees are continuously extracting earth. These contributed to the rapid change of elevation lines at the river. Although typhoons also contributed to the change of the route of the river; thus, the effect of quarrying aggravated the floods

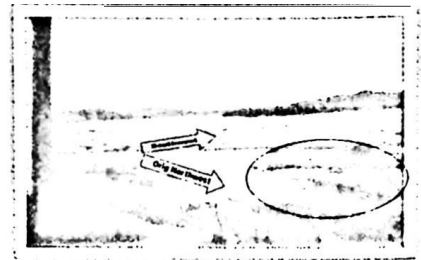
among barangays on the downstream. Some farmlands of adjacent barangays were washed out. These eroded the river bank. When permittees continuously extract sand and gravel at the river banks, the silted earth that are embanked at the center of the river were not removed and this divides the flow of the water, causing eroded banks, and definitely flooding of the affected areas.

Today, extraction of the earth at the aforementioned quarry sites is minimal. Only a few contractors are allowed by the municipal government to quarry. According to the officials of Bio, Tagudin, the haulers pay a minimal amount of toll fee and also there has been an increase in their barangay fund. With quarrying, they were able to put some barangay projects like pavements, roads, basketball courts and communication gadgets for each barangay official. They said that they like to regulate the quarrying industry to keep them from floods, otherwise, the water will reach their barangay during strong typhoons. This may happen if the silted earth at the mouth of the river will not be removed. Further, a recent research showed that the new elevation turned out to be negative; meaning, the river bed had gone lower than its original elevation (Amistad, et al., 1996).

### Quarry Sites in Ilocos Norte

The quarry sites in Ilocos Norte are also rivers which provide a great source of livelihood like sand and gravel hauling. About twenty years ago, there were tracts of land along the river banks. The mouth of the rivers were not so wide. Quarrying was and is still allowed in the place. Contractors and other haulers used pay loaders and shovels to extract sand and gravel, leaving behind deep excavations which would, in turn, be replenished after the rainy season.

According to some of the residents, they wish to stop quarrying because some are already getting aware of the bad effects that quarrying would bring in the future. However, the provincial government allows contractors to extract at a regulated volume. In a way, a considerable amount could be realized because of the taxation of aggregate quarrying. Some have put up barangay roads and pavements.



*Figure 6. Rioeng, Laoag City. Some accumulators (encircled area) were displaced due to quarrying operations.*

**Sta. Monica, San Nicolas.** Along its river, sand and gravel are being quarried from which the barangay also generates income. During actual hauling operations, barangay residents complain about the dust generated by the dump trucks as they travel along the unpaved barangay roads.

In the rice fields, the residents are also gifted with a different type of soil, the "pila" which they use in making jars and cooking pots, comparable to the Bulala clay, in Vigan City. Some pot makers purchase the clay in sacks, necessitating to dig one-to-two meter

deep holes in the fields. As the planting seasons come and go, the holes level off. To them, the clay extraction is beneficial because it naturally levels their fann lands.

**Paoay,** The sand dunes of Paoay are high, approximately 10 m high, about half a kilometer long. Quarrying had been done on the northern end; and slowly the excavations progressed until such time that the operations had become so disturbing to have caused dust to be widespread over an extensive area.



Figure 7. *Paoay, Ilocos Norte. The cohesion of sand dunes are being disturbed and now prone to erosion because of quarrying.*

Sand is an aggregate possessing low cohesion. For sand dunes, once the heap is disturbed, erosion is triggered. The left volume would disperse.

**San Cristobal, Sarrat.** According to the residents' testimony, the original course of the river had shifted to its present route. The change in course was primarily brought about by the continuous, unplanned extraction of gravel where excavation was concentrated at a side, pushing and leaving some on another side. The pushed and left volumes accumulated and rose to a certain height which eventually obstructed the flow to another direction.

Quarrying is not monitored here by the DENR.

**Bengcag, Brgy. IV and XV, Laoag City.** Like all other quarry sites, the people of Bengcag, Barangay IV and XV, Laoag City has noticed similar effects of uncontrolled quarrying. This prompted the local government to manage quarrying in such a way that they set up limitations as to the manner of quarrying employed. Extraction could not be done beyond a depth of 1 meter. Likewise, no extraction should be undertaken within a distance of one kilometer from a permanent structure. The Barangay Tanod conducts the monitoring with P100.00 remuneration per day, which is being funded out of a toll fee of P2.00-5.00 per truck load depending upon the capacity of the loaders. In a way quarrying is an income to the barangay and has realized several projects, like improved road pavements, purchase of hand held radios for better Tanod operations as well as funds for livelihood projects among the five *puroks* of Bengcag.

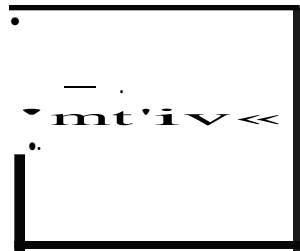


Fig. 8. *Bengcag, Laoag City. The river bank widened at Bengcag quarry site as a result of the uncontrolled hauling.*



Despite the advantageous impacts of quarrying, the people assessed some disadvantageous effects: dusty road inducing air pollution due to the continuous handling of aggregates and noisy environment due to the heavy equipment passing to and fro the barangay streets. The dusty roads are being attended to by regular watering.

### **Quarry Sites in La Union**

**Sudipen.** Geographically located to be neighbors, both Sudipen and Bio quarry sites emerged due to the Amburayan River. Quarrying operations in Sudipen is westward from the southern abutment of the bridge along the National Highway, while the quarry site of Bio, Tagudin is westward from the northern abutment of the bridge. However, going eastward from the southern end of the bridge is a crushing plant of a big time construction firm based in Ilocos Sur. Lying oppositely at the banks of the Amburayan River, the Sudipen and Bio (Tagudin) sand and gravel quarry sites have caused tremendous widening of the river banks and shallower river bed. This situation occurred because when the volume of water from the upstream is huge, water spreads out to the banks, flooding the neighboring areas, farms and houses alike. The Sudipen river banks were so close to the houses. During summer, quarrying contractors undertake full blast operations in stockpiling sand and gravel aggregates, for massive hauling into their respective production yards. Because there are contractors who set up their apparatuses for screening and grading of aggregates in both banks (Bio and Sudipen Quarry Sites), the gravity of scraping operations is quite high. As a result, some sections of the bank are deep, some are shallow. After the quarrying operation, there will be uneven elevations. When the seasonal floods come, the uneven banks will be filled up again, not exactly on the same area, but extending gradually over a wider space outward the periphery of the river bank.

**Rosario.** During the conduct of the observations, there was no quarrying operations in the place. However, traces that it was once a busy quarry site was evident. The river itself was silted and *its* mouth had gone too wide. Rice hull deposits accumulated on the northern side, close to the bridge. If originally, the direction of flow ran perpendicular to the line of axis of the bridge, now the water tends to flow at some 10° shift hitting the southern abutment of the bridge. When the abutments, which are rigidly fixed at a stable ground, are eroded, this weakens the bridge foundation, scouring the area, then leading to the collapse of the abutments. On a long term perspective, the redirected flow of the river due to irresponsible deposition and disturbance would change the course of the river, making the designed orientation of the bridge inappropriate for the flow.

**Luna.** Nature is so strange why it blessed the Luna beaches to solely provide the quarrying site of attractive rounded granules. The beauty of the aggregates were so unique. As caught fresh in photo are the stones mined from the place, screened for uniformity into different diameters to suit the specification of the architect or engineer in the finishing



Fig. 9. *Luna, La Union. The Luna beaches are graced with uniformly-sized and smoothly rounded tiny stones used as finishing to walls and walkways in buildings.*

aspect of any structure. However, due to the rampant extraction, the cohesion of the Luna beaches has weakened.



*But this quarrying is weakening the cohesion of the beaches.*

### Quarry Sites in Pangasinan

Bugallon and Labrador. Moving towards southern part of Pangasinan, the researchers encountered Bugallon and Labrador quarry sites. The river stretch comes from the mountains in the east, passing through barangays leading to the South China Sea in the west. The eastern barangays allowed quarrying to the detriment of those in the western barangays, because the river had grown wide, permitting floods to damage adjacent farmlands and houses.

The researchers witnessed the street lights illuminating their barangay roads at night. The "street lighting project" was funded by the barangay's share from the quarrying taxes. On one perspective, the barangays were benefited from the sand and gravel quarrying as a source of income. However, the older residents claim that floods now are worst than those they have encountered before. If only the river banks were still in place, the river would still be deep. Quarrying's impact was bad, when seen from a long-term perspective.

**Anonang, San Fabian.** There was an observed dynamic impact of quarrying in this place. There were noisy sounds of dump truck engines going to and from the quarry site, causing dusty atmosphere, and fast degradation of concrete paved roads due to the frequent heavy weights carried by the hauling dump trucks.

However, when seen at a different perspective, there was an advantage brought by the quarrying operations in the place because of the barangay shares (40%) in the taxes collected from the quarry contractors. The barangay council set aside the total collection to be used in the construction of a one-room extension of their school. At present, the school building is being utilized as a kindergarten class.

**San Jacinto.** Upon reaching the area, the researchers immediately noticed the vast tracts with intermittent sand and gravel deposits, suggestive of the place to be once a productive ground of rice, corn and vegetables. Due to continuous quarrying, as confirmed by the residents interviewed, the river bank which provided the transition from the bed to the natural ground elevation had grown wider. The river bank has extended to nearby farmlands. During rainy days, the floods brought along sand and gravel, depositing volumes to the river bank extension, and gradually ate up the top soil which supported vegetation. Today, hectares of unproductive soil offers nothing to the San Jacinto folks, the lands which have caused a few businessmen to become richer, leaving behind a helpless community to benefit from the land and river, the only things which the poor could claim to be their own.

## Conclusion

In the light of the above findings, the researchers draw forth the following conclusions:

1. During floods, two phenomena happen. One, the river could carry along its journey sand and gravel from the mountains as a result of eroded mountains caused by kaingin; then deposit them to lowland rivers, somewhere at the center, which would pile up causing the elevations to rise at retarded flows. Another phenomena is that, the water washes out the finer materials down on the bed, forcing boulders or smaller particles (more commonly named gravel) to come out. Whatever of these phenomena happen, there will be a change in the route of the water. This happened in most of the quarry sites of Ilocos Norte, particularly in Rioeng, where the flow of water was considerably diverted from an originally northwest to southwest. The effect of quarrying in Ilocos Norte has been generally caused by a disturbed course of the water flow which tend to a changed direction of the flow. Most of the depositions were concentrated at the center, causing a) a divergence in the flow, b) a shift or changed direction in the flow, or c) a meander.

2. The local government units of Ilocos Norte and La Union have been implementing ordinances to protect their environment, per testimonies of respondents.

In Bengcag, Laoag City, the barangay council monitors the quarrying thereat. The depth of extraction should not be lower than 1 meter. No quarrying are allowed within one-kilometer from any structure.

Likewise, the Provincial government of La Union recognizes its role to regulate quarrying by enacting Ordinance No. 16-92 prohibiting the extraction of sand and gravel with the use of mechanized equipment and/or shovel and banning the picking of stones in

selected shorelines because of the noted degradation and depletion of the shorelines of Luna, La Union, with the affected barangays of Magallanes, Victoria, Sto. Domingo Sur, Sto. Domingo Norte, Rimos 1, 2,3,4 and 5.

3. River quarrying poses potentially significant negative impacts to the environment. The operation of scarifying to push and accumulate sand and gravel aggregates at the banks, and extending to the river bed by the use of heavy equipment, (e.g. pay loader, backhoe, dump trucks) disturbs the natural cohesion of the soil. As a result, the river bank is destroyed and the mouth of the river widens. During rainy seasons, when the upstream volume is large, flooding results, depositing sand and gravel to the vegetative level, setting an incidence which gradually causes the top soil to be washed out, making it unable to support plant life. This then leads adjacent lands to become barren.

## Recommendations

In the light of the foregoing findings and generalizations, the researchers offer the following recommendations:

1. More intensive and participative information dissemination campaign, involving the academe, Local Government Organizations (LGOs), and Non-Government Organizations (NGOs) should be done in order to arouse the awareness of residents regarding the environmental effects of quarrying, as well as other activities being conducted which are already abuses against nature.

2. There should be formulation and strict implementation of laws seeking from quarrying contractors mandatory payoffs to finance environmental projects to rectify the damaged environment due to quarrying.

3. For the government, specifically the local government units to levy taxes, as counterpart to the contractors in the execution of Recommendation #2 which should go directly to affected barangays where the quarry sites are located.

4. To encourage other environmentalists to conduct more in-depth analyses of other sectors of the environment being overlooked and abused.

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