



MINING SAND, FOCUSING ON OROKOLO BAY SAND MINING PROJECT IN PAPUA NEW GUINEA

A DESKTOP REVIEW FOR MAKATA

ABSTRACT

Sand mining is becoming a rapidly growing industry in Papua New Guinea because of its simple nature and being a high profit-making industry, although without much oversight by the responsible government agencies. Experience from this kind of industry indicates catastrophes on the environment and social settings in the vicinity of its activities. This document focuses on proposed Orokolo Bay Sand Mining Project of Papua New Guinea, its development plans, potential impacts and recommends areas of interest for policy focus.

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I would like to take this opportunity to thank Mr. Wenceslaus Magun, Environmental Scientist with funding support from Makata.

With this support I was able to do a quick desktop research on the Orokolo Sand Mining Project in hope to guide the development of a policy framework on sand mining in Papua New Guinea.

Summary

Sand mining although new to Papua New Guinea seems to be forming the frontline mining industry of which many are taking place illegally particularly in rural settings. It has been noted that there are many sand mining activities going on throughout the country but there is currently no record on how many, limited by being unable to gather information from relevant government agencies and other entities for further research as well as needed funding to investigate on site. It also seems that Papua New Guinea does not have any policy or legislative frameworks at this stage to guide sand mining in the country.

The only two sand mining activities that got the governments attention or got the attentions of other major stakeholders are the (i) the previous shoreline sand mining in Madang's Sungilbar District. The people of Madang successfully put stop to that activity in solidarity by pressuring the PNG government and (ii) the proposed Orokolo Sand Mining Project at the mouth of the Kikori River, in the Gulf of Papua, which is going to be a large-scale sand mining project if endorsed by the Government of Papua New Guinea. The Orokolo Bay and mining project is currently under discussions.

This desktop research supported by **Makata** focusses on the Orokolo Bay Sand Mining project, its ownership, the economic benefits, project development plan and the environment and social implications. The research findings indicate the project is positioned in a very fragile marine ecosystem and culturally sensitive area for PNG and in a strategic business location for the project developer. The project belonging to Mayur Resources Limited, an Australian mineral exploration and energy company, will be part-funded and operated by Chinese Titanium Resource Holdings Limited, a company registered as live in Hongkong.

Abbreviations

CEPA – Conservation and Environment Authority

CTRH – Chinese Titanium Resource Holdings

CTRHL - Chinese Titanium Resource Holdings Limited

MD – Managing Director

MIPP - MR Iron PNG Pte

MIPPL –MR Iron PNG Pte Limited

MR- Mayur Resources

MRA – Mineral Resource Authority

MRL – Mayur Resource Limited

NFA – National Fisheries Authority

OSMP – Olokoro Sand Mining Project

1. Introduction

This is a desktop research finding of Orokolo Bay Sanding Mining Project in Gulf Province of Papua New Guinea. Industrial sand mining is new in Papua New Guinea and communities and Local Level Governments (LLG) in areas where sand mining is taking place are concerned of associated impacts on the environment and socio-economic benefits as there seem to be no government oversight on the industry in terms of legal framework policing the operation of such industry. So the main purpose of this desktop research is to provide necessary information to guide a position paper on a policy framework for sand mining in Papua New Guinea.

The report outline includes a background information on sand mining – what is it, its value, the economic returns and benefits. It also highlights the related environmental and social consequences and/or impacts as well as policies and regulatory frameworks internationally and in Papua New Guinea.

Section 3 of the report discusses sand mining in Papua New Guinea briefly outlining the Madang case and then following on with the major write up on the Orokolo Bay project. Areas highlighted for the Orokolo Bay project (i) Company profiling – which company/ies is/are involved and why. (ii) the project development proposal (iii) Community concerns and the (iv) the government's position on the project.

Section 4 the author's own analysis from the collections, section 5 a conclusion from the findings and Section 6 of the report outline some recommendations and then Section 7 references.

2.0 Background on Sand Mining

2.1 Sand Mining



Sand is a granular material composed of rock and mineral materials. It is defined by its size, having to be finer than gravel but coarser than silt to be considered sand. Sand mining is the process of extracting sand from an open pit, sea beaches, river banks, deltas or inland dunes.

The main reason for mining sand is to **provide sand for concrete**, which due to urbanisation boom all over the world, is in high demand. The top four sand exporting countries are USA,

Netherlands, Germany & Belgium and according to the Observatory of Economic Complexity (OEC), the world's largest importer of sand is Singapore, which import 13% of the world's sand. After Singapore the next largest importer of sand are Canada (11%), Belgium-Luxembourg (9%) and Netherlands (6.2%) as reported by World Atlas on '*Top Importers of Sand*'. Sand can be used for various types of manufacturing, such as concrete used in the construction of buildings and other structures. Sand can also be used in road construction and other construction works.

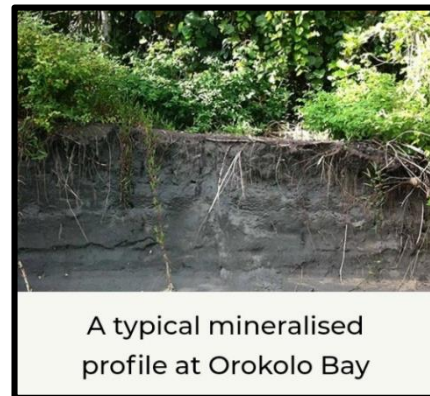
On top of that, sand mining is a very profitable business at low cost. Globally, sand mining business is \$70 billion industry, with sand selling up to \$90 per cubic yard.

(<https://en.m.wikipedia.org>). It is an easy, lucrative business venture – and one with violent underbelly. Being part of a “sand mafia” can seem attractive because it is a **low-risk, high-profit enterprise** that does not require much specialist equipment.

2.2 Environmental concerns

Nonetheless, sand mining also has environmental and socio-economic implications. Large-scale sand mining not only destabilise the banks and river beds but also affect the natural flow of rivers. This causes **risk of floods**. A 2019 overview of sand mining in Kerala-India, showed how illegal mining of rivers had played its part in aggravating the severe August 2018 floods. (<http://en.gaonconnection.com>th>). On 16 August 2018, severe floods affected the South Indian State Kerela due to unusual high rainfall in nearly a century in which over 483 people died, 143 went missing and an estimated US\$56 billion property damaged. In 2016 research indicated the area located on high slopes with massive mining operations going on with no scientific mining policies in place were of possible risk but the state failed to take action until after the August 2018 flooding disaster when they took mandatory precautions including evacuating 35,000 people from disaster prone areas.

As a process of land degradation, sand **winning-mining** destroys the soil profile, damages soil surface configuration and changes topography of the land. (Mehta et al., 2007, <https://core.ac.uk>download>pdf>). Excessive instream and sand-and-gravel mining causes the degradation of rivers. By removing too much sand from rivers, sand mining also leads to the erosion and shrinking of river banks.



A typical mineralised profile at Orokolo Bay

2.3 Social-economic impacts of sand mining

Sand mining can impact local communities both positively and negatively. While positive impact such as employment and community projects are important, they do not off-set the potential negatives particularly forced migration in search for land and new homes. (<http://www.oxfam.org.au>impact>).

Advantage of sand mining:- Job creation creates new tax revenues, especially on local level, Building a new facility and hiring employees generate more income for local and provincial governments. (<http://winconsinsand.org>economy...>)

A disadvantage of sand mining is that it leads to loss of fertile land and property. It also destabilizes the ground and causes the failure of bridges, dikes and roads. (13 Nov 2018; <http://www.worldatlas.com>article>)

Quarrying for sand and gravel may not be as exciting as other businesses but **it is still very profitable**. Both materials are in huge demand for construction purposes and supplying large amounts can give you a large pile of money. (<http://athomeinthefuture.com>>ma).

Prices of sand ranges from **between \$5 to \$30 per ton**, depending on type. Natural sand will typically cost less than specialty sand. Screened sand costs about \$15 to \$20 per cubic yard and it is suitable as a base for paving projects like drive ways. (5 May 2021; <http://www.homeadvisor.com>>co)

2.4 Policies and regulatory Concerns

Sand mining is regulated by law in many places, but **is often done illegally**. Globally, it is \$70 billion industry, with sand selling up to \$90 per cubic yard. (<https://en.m.wikipedia.org>) Unregulated sand mining is a problem in at least 70 countries (<http://www.newscientist.com>.) *It is an easy, lucrative business venture – and one with violent underbelly. Being part of a “sand mafia” can seem attractive because it is a low-risk, high-profit enterprise* that does not require much specialist equipment. *However, it is also a legal grey area.* There are no coherent international laws forbidding sand mining. Where local regulations exist, they aren't always enforced especially in remote areas.

With international conventions mandating the adoption of state laws and regulations to protect and preserve the marine environment and biodiversity, and regional conventions offering more guidance, but again differing licensing and permitting to states, the bulk marine sand mining legislation is established and.. (The International Legal Framework of Marine Sand Mining and its... <http://cmla.org>>papers).

3.0 Sand mining in Papua New Guinea

3.1 Madang

A campaign to stop sand mining along 38 kilometres of Papua New Guinea's Madang coast has been successful. (RNZ Pacific Papua New Guinea – [amp-rnz-co-nz](http://www.rnz.co.nz), 1 March 2021).

A Singaporean company, Niugini Sands, had applied to mine sand but concerns were raised about impacts on coastal communities and the environment, which includes nesting grounds for endangered leatherback turtle.

A court Injunction was sort to try to force the Mineral Resource Authority to conduct further consultation with communities within the Sungilbar local government district, but were advised by MRA that the company had withdrawn its application to mine the sands. The company admitted environmental sensitivity of the area and said the sand was of low quality.

Stricter standards needed for sand mining (<https://www.national.com.pg> – 19 March 2021). PNG's Environmentalist Wenceslaus Magum said stricter standards are needed for sand

mining after accepting the decision by Singaporean-based company Niugini sands who withdrew its application to mine sand on the coast of Madang.

However, on 11 May 2021, it was reported again on The National that Mayur Resource Ltd is close to developing the country's first iron and industrial sands project in Orokolo Bay, with its mining Lease being assessed by the MRA. According to the Managing Director Paul Mulder, MRA had already received the application earlier in 2021 on the company's K60m project were assessing it and emphasizing on the benefits regardless of not being a large project. To this date, ...?.. is unaware of stage on the policy development concerns from the relevant agencies in regards to sand mining.

Also noted is that, there is another project in the pipeline at the same location and that is of multiple mechanized sago operation by International Financial Corporation and Total, a French energy firm.

3.2 Orokoro Bay Sand Mining

3.2.1 Location

The proposed Orokolo Sand Mining project is located at the mouth of the Kikori River in Ihu District of Gulf Province of Papua New Guinea. The project's tenement covers more than 10,000 square kilometres in the Gulf of Papua and owned by Mayur Resource Limited, an Australian company.

3.2.1 Project Development Proposal

The Orokolo Bay Project is proposed to be developed in two stages, Stage 1 is the pilot plant comprising the construction, commissioning and operation of a pilot scale bulk sample '**that is already environmentally permitted**' to produce up to 100,000 tonnes of iron ore sands per annum over a 2-year period, principally for the purpose of providing test scale shipments of produce to potential off takers, with the endeavour they will then sign legal binding long-term offtake agreements the Full-Scale plant.

Stage 2 is the Full-Scale Plant. Subject to the outcome of the Pilot Plant Bulk Samples including customer acceptance of the product, obtaining the required permits and landowner consents for the Full-Scale Operations, as well as the Definitive Feasibility Study, it is proposed to extend the capacity of the Pilot Plant to achieve total production capacity of 800t/h run of mine (ROM) feed rate. In addition, a processing circuit is to be installed to separately produce construction sand and crude zircon concentrates in separated form.

The projected life of the mineral sands project is 15 years, and will be a 'standalone' operation. The project has its own wharf and will receive goods, and export goods, off that wharf. According to the Managing Director, Paul Mulder, there will be no environmental implication because there will be no chemicals, no grinding and it is not a difficult terrain.



3.2.2 Project Development Capital

Mayur Resources Limited has secured up to US\$25m in funding from China Titanium Resources Holding Limited (CTRH) for a 49% stake in Mayur's Subsidiary MR Iron PNG Pte Limited (MIPPL) to develop Orokoro Bay Industrial Sand Project in PNG.

(<https://www.proactiveinvestors.com.au>)

The subsidiary holds Orokolo Bay Project as part of Mayur's prospective industrial mineral sands portfolio in Papua New Guinea.

The agreement has been successfully concluded following a number of discussions, site visits and detailed due diligence. The project's tenement covers more than 10,000 square kilometres in the Gulf of Papua.

The legal-binding term sheet has been signed and definitive transaction documents are expected to be completed by the end of January 2019. CTRH has secured exclusivity and made a legally-binding commitment to co-fund the Orokolo Bay Pilot Plant and fund the full-scale operation.

3.2.3 Interest Parties in the Orokolo Sand Mining Project

The main interest parties in the proposed Orokolo Sand Mining Project are of course Mayur Resource Limited, Chinese Titanium Resource Holdings Limited and Dentons Rodyk at the project initiation stage.

3.2.3.1 Mayur Resources Limited - PNG Pte Ltd

Mayur Resources Limited is an Australian-based diversified mineral exploration, development and energy company. The company listed on the Australian Stock Exchange and has had 20 exploration licenses granted by Papua New Guinea for exploring and developing mineral and energy development opportunities in Papua New Guinea and neighbouring countries. <https://www.reuters.com/companies/mayurresource> MRL was founded in 2011, its parent company is DTJ Co Pty Ltd and headquarters based in Australia. Subsidiaries of MRL are MR Power Generation, PNG Pte Ltd., and Mayur PNG DRI & Steel Making. PNG Pte Ltd, the subsidiary company of Mayur Resource Limited takes lead in the Orokolo sand Mining Project.

3.2.3.2 Chinese Titanium Resource Holdings Limited

Chinese Titanium Resource Holdings Limited is a live company incorporated on 25 September 2015 (Friday) in Hong Kong as a private company limited by shares entity. The private company limited by shares has been operating for 5 years and 345 days since then. CTRHL's registration No:# 2290679 as reported by HKG Business (<http://hkgbusiness.com>).

Apart from its partnership with Mayur where it plans to build a pilot sand processing plant in Orokolo Bay in the Gulf of Papua in Papua New Guinea, little is known about the business of CTRHL. It is understood that the decision of CTRHL was based on the advice provided by Dentons Rodyk team, which among others was the 'subscription and shareholders' agreement for the investment. That is, the deal concerning the provision of US\$25 million in funding for up to a 49% stake in MR Iron Pte Ltd. (<https://dentons.rodny.com> , 5 April 2019, Singapore)

3.2.3.3 Dentons Rodyk

Dentons is the world's largest law firm, delivering quality and value to clients around the globe. Dentons is a leader on the Acritas Global Elite Brand Index, a BTI Client Service Award winner and recognised by prominent business and legal publications for its innovations in client service, including founding Nextlaw labs and Nextlaw Global Referral Network. Denton's polycentric approach and world class talent challenges the status quo to advance client interest in the communities in which we live. In April 2016, Dentons and Singapore-based firm Rodyk combined forming Dentons Rodyk in Singapore. (<https://www.dentons.com/en>)

3.2.4 Why Chinese Titanium Resource Holdings as a partner

Two main reasons why MRL is drawn to CTRHL is firstly because they have the capital and secondly according to Mayur's Managing Director, Paul Mulder, is because of their expertise in sand mining business. He adds that having the production expertise of CTRH, with their proven capability in low cost mining and quarrying, will assist Mayur in putting PNG on a fast-track process to becoming a mineral sand exporter.

Mayur MD Paul Mulder said: “In addition to providing development capital funding, CTRH will also take on working capital and operational risk through the Orokolo Bay pilot plant phase while agreeing on to take funding responsibility of up to US\$25 million to build stage II full-scale plant. Mayur retains a 51% stake in the potential future economics of the US\$106-million net present value of the Orokolo Bay project as documented in the pre-feasibility study that was included in Mayur’s project.

So in other words, as understood, CTRH will be in total control of the pilot as well as the construction phase of the second and final stage of the project. Mayur takes its slice of the cake 51%) beginning operation of the final stage of the project to its end.

3.2.5 PNG as a strategic location for business

Mayur Resources is committed to development of economic growth and nation building of PNG, creating pathways to local and national prosperity.



Mayur’s strategy is to build and develop a diversified portfolio of resources and energy opportunities in a developing jurisdiction that:

- Is geographically well positioned to take advantage of opportunities in both PNG and the wider Asian Region
- Offers protection against the cyclical nature of commodities through vertical integration
- Comprises projects that are in the first quartile of the global coast curve of comparable resource projects.

And PNG lies in that strategic location for resource development opportunities. As located on the map in Figure: .., there are four interest projects eyed by MR of which three are in the Southern region and one in Momase region of Papua New Guinea.

Mayur’s strategy recognises the unique and often under-recognised potential of Papua New Guinea. The diverse nature of Mayur’s business is able to leverage the unique aspects of a jurisdiction that is fast emerging as a developing nation on the doorstep of Asia. It is this exciting stage of PNG’s development, coupled with its world-class mineral inventory that has and will continue to underwrite Mayur’s delivery and execution plans across its portfolio.

3.2.5.1 Benefits

According to Mayur, PNG benefits from the following.

- Proven mineral potential in one of the most geologically active and prospective regions of the world;
- A well-established mining sector, home to a number of mining developments;
- Supportive governments and a stable legislative environment and policy mechanisms;
- Favourable mining fiscal regimes and competitive tax on income;
- A mining and petroleum sector that continues to drive the growth story enjoyed by one of Asia's fastest growing economies;

Mayur's vision, missions and objectives and other relevant information are outlined on their webpage

<http://mayurresources.com> .

3.2.5.2 Potential Mayur projects in Papua New Guinea

MRL has other business interest in PNG apart from the Orokolo Sand Mining, some of which are indicated below.

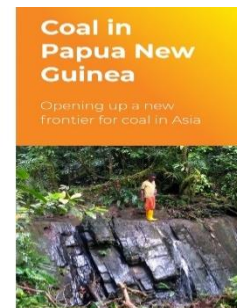
1. Central Cement & Lime Project

Large-scale, high grade, coastal limestone deposit in PNG with opportunity for vertical integration 25km North of Port Moresby.

2. Coal in PNG. Mayur holds a portfolio of tenements that cover the main coal bearing geology in the Papua Basin in Southern PNG. Although there has been a long history of coal prospecting in the Gulf Province, coal mining has never been developed in PNG, unlike its neighbours in Indonesia and Australia.



Drilling at Port Moresby Limestone Project



3.3 Community reactions to sand mining in Orokolo Bay

In response to the interest and plan of Mayur Resources to develop a sand mine processing plant in the Orokolo Bay some reaction of community members were captured as shown below. Comments were in response to an article 'mineral sands and sago' by David James on 3 May 2021 on the Business Advantage PNG website.

Comments

Julian AINU says
6 Mar 2021 at 1:48 am

Is Mayur Resources Registered or have:

1. PNG Investment Promotion Authority (IPA) Certificate?
2. Internal Revenue Commission (IRC) Certificate Of Compliance(COC)?
3. Conservation Environment & Protection Authority (CEPA) Permit/License?
4. Energy/Mineral Resources Permit/License ?
5. MOU/MOA in place?
6. Project/Business Profile in place?
7. Consulted the Landowners concerned?

Mayur Resources;
PLEASE JUSTIFY YOURSELF IN REGARDS TO THE 7 LISTED ISSUES ABOVE...

Reply

STANLEY HARU says
4 Mar 2021 at 8:03 pm

I am a landowner from this project Site known as Muro Black sand Project found in areas known as Huruta and Ere Kilavi. There a lot of aspects of this project that are not fully regulated under state laws and where they are acknowledged are ambiguous under mining laws. Further the current laws do not protect landownership interest in a project of this magnitude such that the laws that decide on benefit to landowners is NON EXISTING and any benefit is left to the whims of the project operator and in this case Mayur Resources. Can the company spell out what are the specific benefits the landowners are getting. For mega projects, State takes up a percentage whereby some are offloaded to landowners as equity interest. This is not the case here so can Mayur tell us how much you are giving as equity in the project to or what benefits are you giving us?

Further, this is a small scale operation such that it is not getting the same hype as Wafi-Golpu such that project operator is not closely monitored and abuse will go on unnoticed by State entities and laws are not very clearly defined for such operations and need to be tightened up and benefits must be clearly spelt out for Landowners especially for small project of this magnitude

In terms of sago harvest- have you done a socio-economic study on the production of sago. Let me put things into perspective for your ignorance- it takes 10-15 years for a sago tree to be ready for harvest, we only cut trees for our food supplement for at least a month any longer the sago becomes stale. We only harvest what we need – therefore any large scale harvest will deplete supply and long term create food shortages for the population at large. You must understand that sago will be our only food source during flooding season when we can not make garden to grow other crops and sago will be our only food source during time over extreme dry weather conditions. Unless you talk about developing sago plantations for food dont talk about large quantities of harvest like in Poroi or better still come up with alternative source of food for my people like wetland rice or food that is durable in the flood plains

Reply

Janette Edwards says
4 Mar 2021 at 12:40 pm

I was born in New Guinea so it's good to hear they won't destroy the habitat

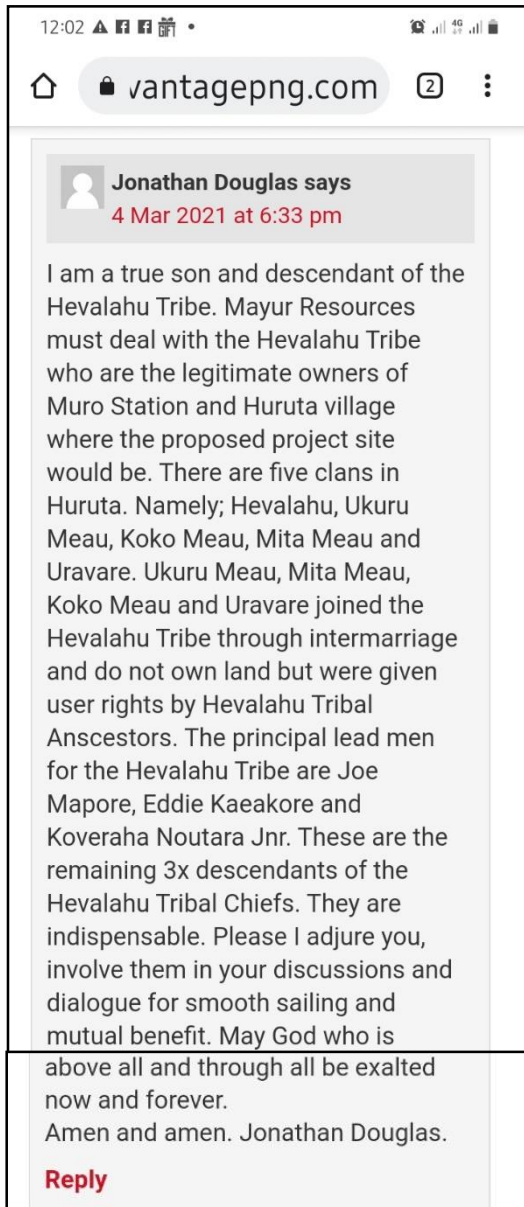
Reply

John Koaire says
4 Mar 2021 at 6:44 am

It's a good project, but make sure you deal with the true resource owners. Many don't have the resources but they use false information.

Reply

As it seems, the communities are concerned that this project may be rushed without proper legal processes. They are also concerned about the impacts of the project on their livelihood with regards to food security and culture.



3.4 The Orokolo Bay

7.1.1 Community and Social Settings

It is noted that Orokolo Bay is known for its archaeological significance not just to the people Orokolo Bay and PNG but also to the world at large. It a huge subject of its own and is of historical importance to those connections. Orokolo Bay archaeological significance draws interest from research institutions for Australia, USA, and other countries.

7.1.2 Environment & Natural Resources

Like any other places in the Pacific and particularly PNG, Orokolo likes in a pristine and very rich biodiversity area in marine, freshwater and terrestrial ecosystems which houses some of PNG's unique wildlife species. It holds some of the counties mangroves which need to be researched further. This once again need to be explored and properly researched so to be archived as baseline information for the environment prior to any disturbance.

7.2 The PNG Government position on Orokolo Sand Mining

This review did no government interviews apart from information gathered from a desk-top review which seem to indicate that the government in under pressure to pursue this

Orokolo Bay Sand Mining Project. It should also be noted that in March 2021, the Madang Coast Sand Mining ceased operations because the Mineral Resource Authority had withdrawn its mining application due to pressure from the NGOs and the local government for the protection of the coastal communities and the nesting grounds of the endangered leatherbag turtle as well as taking a court injunction for more public consultation prior to mining sand. It was from this event that the government noticed there are no policies yet for sand mining development projects in Papua New Guinea.

In another instance, it has been noted that the Mayur claims an Environmental Permit has already been granted for the Orokolo Bay Sand Mining Pilot Project. This however, has to be confirmed with Conservation and Environment Protection Authority. This can be done after a support document is provided to further investigations with government and corporations.

4.0 Analysis

So from this quick desk-top review, it seems Orokolo Sand Mining will eventuate regardless. MRL has done and is doing everything it could to have the project operating soon. The subsidiary company MR Iron PNG Pte Limited (MIPPL) of Mayur Resource Limited is now been resourced by CTRHL to mine sand in Orokolo Bay based on legal advice provided by Dentons Rodyk, a Singaporean renowned law firm. It is important to note that it has been indicated in some articles that little is known about the business of CTRHL which contradicts Mayur's Managing Director Paul Mulder's statement that CTRHL has the production expertise. Mulder believes that with proven capability in low cost mining and quarrying, CTRHL will assist Mayur in putting PNG on a '**fast-track process**' to becoming a mineral sand exporter. Also note that financial arrangement decision for engaging CTRHL was based on the advice provided by Dentons Rodyk team.

The project lies in a strategic location for investors or business opportunities as emphasized the MRL Managing Director. It is geographically well positioned to take advantage of opportunities in both PNG and the wider Asian Region, it offers protection against the cyclical nature of commodities through vertical integration and comprises projects that are in the first quartile of the global cost curve of comparable resource projects. So in other words, it is strategically located for any profit-making venture. So with that, additional opportunity to **directly** operate with international connection from the project site is the best way out for any business venture. This therefore require proper scrutiny and regulatory measures to ensure transparency is maintained and there is sovereign control over the entire operation of the project.

On the other hand, it seems there is currently no policy or regulatory framework specifically guiding **sand mining** operations in PNG. That has been the main reason why the Madang sand mining operations ceased in March 2021, following a successful campaign by NGOs in Madang led by Environmentalist Wenceslaus Magun of Makata. Although, logically the devising of a policy framework and the development of one will need a fair bit of time in that all stakeholder inputs are necessary, it seems the project is currently being rushed as reported in the 'The National' newspaper on 11 May 2021. It seems Mayur is determined to have the project in operation sooner and so as it seems, the PNG government could be pressured to fast track a policy that may not capture important concerns of sand mining in PNG.

Literature indicate that sand mining is an easy, lucrative business venture – and one with violent underbelly. Being part of a “sand mafia” can seem attractive because it is a low-risk, high-profit enterprise that does not require much specialist equipment. However, it is also a legal grey area. There are no coherent international laws forbidding sand mining. Where local regulations exist, they aren't always enforced especially in remote areas.

The Orokolo Bay Sand Mining Project is going to be huge in terms of production volume and income generation. After the pilot project at 100,000 tonnes/year for 2 years, which in my opinion is to generate income for the actual operation will produce 7 million tonnes per year calculated at 800 tonnes per hour. If income was generated at the rate of US\$20 per tonne (norm is \$5-30 per ton) that would be US\$2 million per year for the pilot project and US\$140,000,000.00 per year for full production. Being a low cost operation project, it is inevitably going to be a very profitable project.

This research has also noted that sand mining occurs in other parts of the world and USA and Australia are amongst the top countries that export sand and Singapore is the world's largest importer of sand. International conventions mandate the adopting of state laws and regulations to protect the environment and regional conventions offer more guidelines. However, in many areas throughout the world, illegal sand mining has caused severe flooding and hence damages to environment and society in the vicinity. Flooding is not only an environmental catastrophe but is also hurts and burdens society and the economy on a larger scale. The Karela flooding incident in India are clear examples of the consequence of flooding associated with mining.

The environmental implications however, will be inevitably huge as the project is located in high biodiversity area, the Kikori Basin, that houses some of the world's marine resources. The project tenement covers a 10,000 square kilometres in the Gulf of Papua and the removal of 800 tonnes per hour is an enormously large quantity and a disaster to any living organism in and within peripherals of this very pristine and environmentally sensitive location. Although no chemicals will be used in the production process and the project is not located on a slope as pointed out by MRL, sand mining seems a messy project because of enormous amount of sand that will be taken out of the bay. The destruction of the habitat of living organism including the fishery resource that generate income of the country may be at stake. Sand mining projects around the world have pointed out that implications are severe. It is important therefore that proper investigations are conducted to safeguard the not only long-term fishery resource base of PNG and natural environment but also of the local communities and their livelihood (now and in the future) in the vicinity of the mine.

At this stage, even though environment permit has been given for the pilot project to proceed, it is not clear how much community consultation and environmental investigations have been conducted prior to leading to the permitting decision. In addition, various government regulatory measure may also have to be taken into consideration for this project. The successful campaign in Madang by locals to stop sand mining, has now highlighted the policy gap which the MRA, Conservation and Environment Protection Authority (CEPA), the National Fisheries Authority (NFA) and other responsible government agencies admitted occurred and that policies guiding sand mining projects are yet to be put into place. Without public consultation, proper environmental investigation and no regulatory instrument/s, it would be a dangerous act to allow for any operations.

5.0 Conclusion

1. The Australian mineral exploration company, Mayur Resource Limited, is inexperienced and does not have capital to conduct the sand mining business in Orokolo Bay. However, because sand mining is a very profitable business activity and the Orokolo basin has the resource and economic potential and is appropriately located for business with a favourable political climate in PNG, Mayur in pursuit to get the project into operation quickly, is engaging a Chinese company, China Titanium Resource Holding Limited.
2. CTRHL, however, although may have the financial capacity and recommended to MRL by a reputable law firm based in Singapore, and highly praised by MRL for its expertise, it still has yet to be fully researched in depth to reaffirm its credibility in mining sand in a very environmentally and culturally sensitive area of the Orokolo Bay. From this research we have not identified any other sand mining business CTRHL has been involved in apart from the Orokolo Bay Industrial sand project.
3. All international transactions and connections will be direct from the project site once in operation. This means a big industrial township with wharfs, airport and immigration and passport and visa processing facilities. This may invite unexpected social issues due to migration of workers not only from PNG but also overseas apart from pressing ethnic tensions, population increase and hence increased law and order concerns.
4. The project is large and will inevitably implicate environmental concerns particularly on the marine environment and ecosystem of the waters of the Gulf of Papua and hence the consequence decline in the fisheries economy of PNG. Even with little documented baseline information on the Orokolo Bay environment and its ecosystem at the moment from this search coupled with not having an audience with the responsible government agencies especially the NFA and other major stakeholders, it seems the environment and marine resource in the gulf of Papua may be under major threat once the project in in operation.
5. Government entities are irresponsibly abusing the power entrusted to them and such acts could lead to major events that may be difficult to solve easily or cause harm to entities, properties, communities and individuals associated with the project in the future. Issuing of mining and environmental licences for instance, without and guiding policies and/or proper investigations respectively, are liabilities to responsible government authorities.

6.0 Recommendations

1. For Papua New Guinea to have in place a sand mining policy that encompasses also social, political, environmental and economic issues as highlighted in this search. This policy development process should involve all levels of government (National, Provincial and local level), civil society organisations responsible for the various interests (Environmental, Human Smuggling, Gender Based Violence, Human Rights, etc) and the communities in project area and the surrounding communities.
2. For the Orokolo Industrial sands project, major government entities that should participate in the policy formulation should include MRA, CEPA, NFA, Immigration-Foreign Affairs and Trade, Planning, Treasury, Police, Defence, Community Development, Health and Tourism Authority as well as others.
3. Relevant and responsible government entities conduct proper investigations and gather as much baseline information as possible prior to commissioning of the project particularly, CEPA, NFA, National Museum, Boarder Authority and so forth. The information should also be used as a guide to developing the policy.
4. That all government entities should provide no requisite for public access to office and information of their interest to avoid negativity and biased reporting. This avoids conflict of interest and provide good working relationship for the better for all.

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