Possible Environmental and Socio-economic Ramifications of Sand and Gravel Winning in Danko, Upper West Region of Ghana

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Abstract

Sand and gravel winning have been going on in the Danko community since the 1990s and recently escalated arguably triggered by urbanization, population pressure, and proliferation of educational institutions. Other causes include increased demand for housing, improved roads, and other development infrastructure. Even though some studies claimed that sand/gravel mining promotes the socio-economic well-being of stakeholders, others argued that it generates negative environmental and socio-economic impacts on society. These opposing views were tested in the Danko community. In this qualitative dominant mixed-methods study, 15 key informants and 48 survey respondents were consulted to understand the reasons for the proliferation of sand/gravel winning in Danko and its environs and the associated ramifications. The study found that sand/gravel mining has some benefits, including support of the building and road construction sectors, provision of livelihood opportunities, and creation of dugouts for domestic use. Some adverse impacts of sand/gravel winning activities reported were land/environmental degradation, loss of farmlands and marginalization of women. The study concludes that sand/gravel winning has both beneficial and harmful impacts with sustainability challenges. Therefore, all stakeholders must work in an environmentally sustainable and safe manner for the industry to continue to benefit all stakeholders along the sand/gravel winning value chain.

Key Words: Environmental, socio-economic, ramifications, sand and gravel winning, , Ghana

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Introduction

The environment is the bank of natural resources which humankind can and has been harnessing to satisfy some of her needs. Despite the importance of the natural environment, some human activities are also impacting on these resources adversely, thus, threatening its sustainability and regenerative capacity (Karikari, 2013). Sand and gravel winning as resources contribute to the socio-economic growth and development of some nations and at the same time resulting in negative consequences. Some researchers and environmentalists (e.g. Walters-Delpeche, 2012) claimed that the negative effects of illegal sand and gravel winning far outweigh the socio-economic benefits. This begs the question; should sand and gravel winning be stopped despite its benefits to countries engaging in the practice, especially those in low-income countries? This study has particularly, been undertaken to contribute to this discourse.

Sand and gravel winning undertakings are small-scale industrial mining activities with widespread environmental and socio-economic implications in most developing countries (Alhassan, 2010). Sand winning refers to the scooping of sand from portions of the earth surface for building construction and other developmental purposes (Peprah, 2013: 185). Gravel mining, on the other hand, is the extraction of gravel from the earth for road construction and other related developments. According to Hull (2001), sand grains have diameters from 0.002 to 0.08 inch, whereas those of gravel range from 0.08 to 4 inches. This paper explores the environmental and socio-economic implications of these two small-scale open-cast mining activities from the perspective of stakeholders in the industry in the Danko community and its environs.

It is widely reported in the literature that sand and gravel mining have both positive and negative effects (Mireku-Gyimah & Tsidi, 1996; Peprah, 2013; Jonah, Adjei-Boateng, Agbo, Mensah, & Edziyie, 2015; Narh, 2016; Baba, 2017). Some of the negative impacts reported include environmental degradation, water pollution, destruction of the soil structure, facilitating soil erosion with abandoned pits acting as breeding grounds for water-induced diseases and death-traps (Jonah et al., 2015; Narh, 2016, Baba, 2017).

Peprah (2013), reported an upsurge of sand/gravel mining activities in the Wa Municipality and other surrounding peri-urban areas in order to provide the raw materials to support the building industry and road sector. Other studies, such as Narh (2016) and Aromolaran (2012) revealed the occurrence of similar activities in the Dormaa District in the Brong Ahafo Region and Ogun State in Nigeria respectively. This paper contends that the escalating sand and gravel winning activities could be associated with an increased negative environmental and socio-economic effect in the Upper West Region (UWR), with particular reference to the Danko community and its environs.

Even though other researchers studied various aspects of sand and gravel winning in Ghana, only Peprah (2013) investigated "sand winning and land degradation: perspectives of indigenous sand winners of Wa, Ghana." Though the first study to unravel the environmental implications of sand winning in Wa, Peprah's (2013) study only covered perceptions of tipper truck drivers in the sand winning business in Wa. This excludes gravel winning and the socio-cultural and economic implications of sand mining as well as views of other stakeholders in the industry (e.g., sand winning contractors, sand loaders, landowners, and sand/gravel mining regulators). Even though Peprah (2013) also identified Danko as one of the Wa peri-urban communities with a high preference for its sand, Danko was not the focus of his study. This paper intends to fill these gaps as a way of building upon Peprah's study. Specifically, the paper was designed to explore: (i) the reasons for stakeholders' involvement in sand/gravel mining activities, (ii) the environmental and socio-economic effects of sand/gravel winning, and finally (iii) how problems emanating from sand/gravel winning activities can be addressed from a multi-stakeholder perspective. It is anticipated that the involvement of all the stakeholders in the sand/gravel mining value chain would yield a thorough understanding of the environmental and socio-economic effects of sand/gravel winning in the UWR, especially in the Danko community. This has the potential of contributing to the resolution of challenges associated with sand/gravel winning as well as the expansion of the extant literature.

Conceptual Framework

This study was informed by the Brundtland Commission's Report on Environment and Development's (CED) definition of sustainable development (Brundtland, 1985); Serageldin, Steers, and Cernea's (1994) conceptual framework for sustainable development; and Sumani's (2018) agricultural insurance sustainability framework. The Brundtland's Commission Report specifically defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (p. 43). This definition and the associated sustainable development frameworks and ideas guided and directed this research to explore how sand and gravel winning activities can be conducted to maximize inter-generational socio-economic benefits without jeopardizing the ecological integrity.

It is important to acknowledge that the concept of sustainable development has evolved over the years and has also been criticized as being vague and ambitious (Mebratu, 1998). For instance, the Brundtland Commission's definition of sustainable development in the 1990s with a focus on the global planet transitioned to include various environmental components at the local level (Mebratu, 1998). However, this paper is not interested in this debate and stuck to the original meaning of sustainable development. This is because the only known alternatives to sustainable development are either unsustainable development or no development at all (Roberts, 2011), both of which are undesirable forms of development.

Sustainable systems are mainly anchored on three pillars: economic domain, environmental domain, and social domain (Serageldin et al., 1994; Azapagic & Perdan, 2000). Scoones (1998) and Carney (2003) introduced an additional institutional dimension as the 4th domain of sustainable development. These sustainability ideas are relevant to sustainable sand and gravel winning as synthesized diagrammatically in Figure 1.

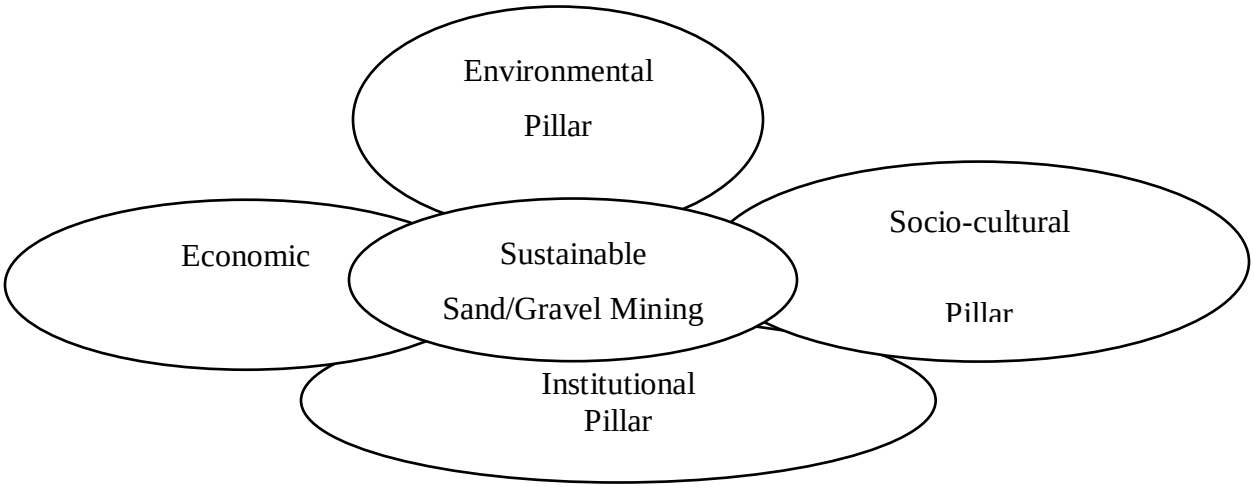

Figure 1: Diagrammatic representation of sustainable sand/gravel winning conceptual framework **Source:** Author constructed (2019) with ideas adapted from Serageldin et al. (1994), Azapagic and Perdan (2000), Scoones (1998), and Carney (2003).

This paper assumes that sand and gravel mining can be conducted sustainably and safely. This sustainability can emerge from the: (i) Environmental pillar, i.e., employing safe mining and environmental management practices, (ii) Economic pillar-mining in such a way that sand and gravel winning activities can yield inter-generational benefits (e.g. income, employment, payment of taxes), (iii) socio-cultural dimension- sand/gravel winning that takes into consideration all-inclusive, gender, and socio-culturally sensitive sites and values and, (iv) institutional dimension-sand and gravel winning activities that involve all the traditional and regulatory agencies. Narh's (2016) sand winning study in Dormaa describes these institutional interactions as interlocking sand winning activities with livelihood strategies also interfacing with traditional and environmental governance regimes.

Materials and Methods

Danko is one of the 34 communities in the Wa Municipality. It is 4.6km South-East of Wa, the Municipal capital. Danko lies on the intersection of latitude $10^{0}01$'N and longitude $2^{0}28$'W and is surrounded by Wa to the North, Sing to the South, Kampaha to the East, and Bamahu to the West as shown in the map in figure 1.

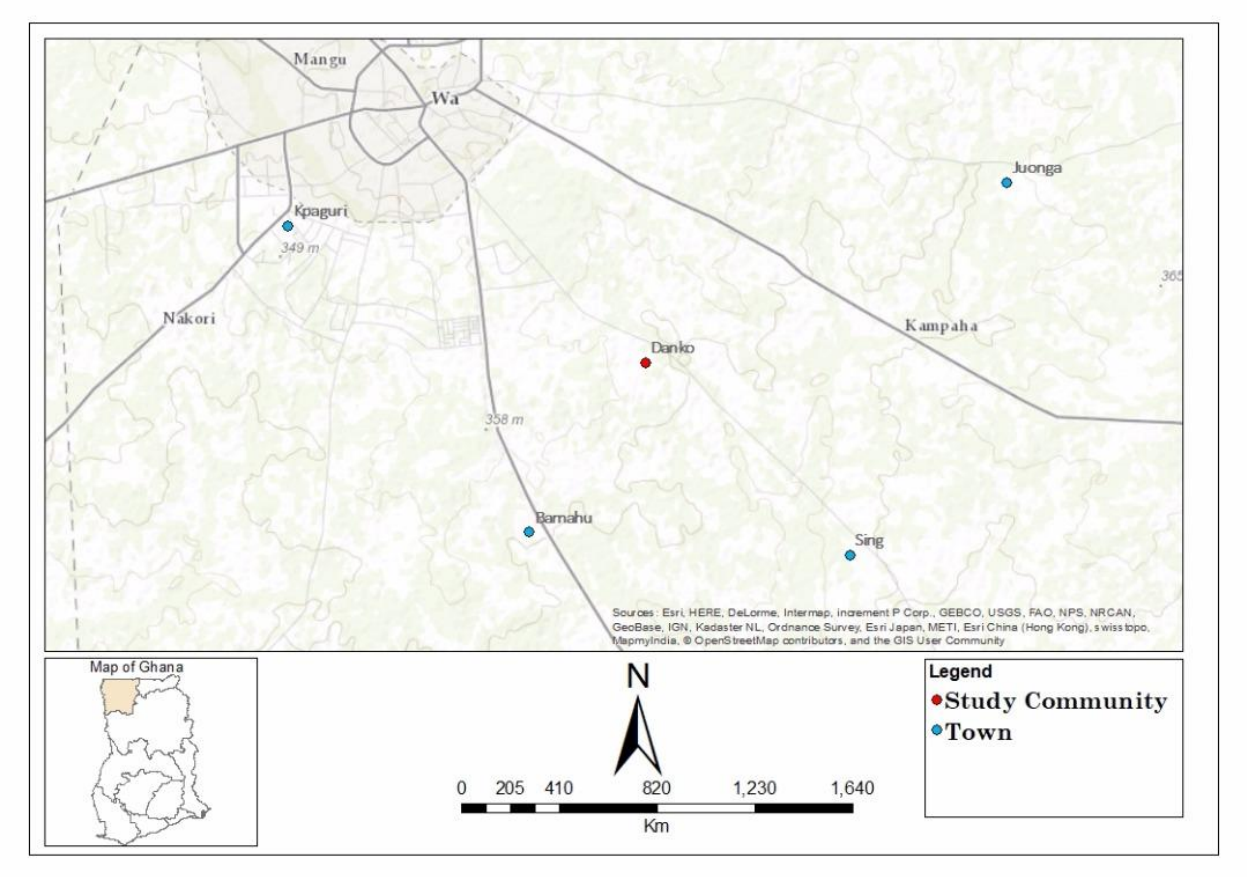

Figure 1: Map showing the Danko community
Source: Constructed by Green Earth Ghana, 2019

According to the 2010 Population and Housing Census (PHC) report, Danko has a population of 1,299 out of the 107,214 and 702,110 total population of the Wa Municipality and Upper West Region, respectively. The females in Danko are slightly more than the males, i.e., 654 females and 645 males (Ghana Statistical Service (GSS), 2014). With increasing conurbation and urbanization, the population of Danko is projected to increase to 1,605 by 2020 (GSS, 2014). The indigenous residents of Danko are peasant farmers. However, the agricultural lands of the Wa peri-urban communities, including Danko, are under threat mainly due to urbanization, population pressure, conurbation, and sand and gravel winning (Peprah, 2013).

This research utilized a qualitative dominant mixed-methods approach. Maximal variation purposive sampling was employed to ensure that views of the varied stakeholders in the gravel and

sand winning value chain were represented in the study. Also, accidental and snowball sampling strategies were also used to select sand loaders, tipper truck drivers and tally card recorders who were chanced upon at the sand winning base stations and were willing to be interviewed while opinions of sand winning contractors and landlords were sought based on the recommendations of other interviewees, respectively. Sand winning associations, mining regulators and other stakeholder agencies (e.g., the staff of Minerals Commission (MC), Environmental Protection Agency (EPA), Ghana Highways Authority (GHA), and the Wa Municipal Assembly (WMA)) were purposively selected to take part in the study. The data were sourced from 15 key informants (landlords, sand winning contractors, tipper truck owners, and regulators) and 48 survey respondents (sand loaders, tipper truck drivers, tally card recorders, and some Danko community members).

Whereas Creswell and Plano Clark (2011) maintained that some qualitative investigators might not want to use definitive sample sizes to constrain their studies, Creswell (2007) argued that qualitative studies could use between 20 to 30 interviewees to produce acceptable results. Even though quantitative studies require large sample sizes to be rigorous and representative of the study population, this paper was not meant to produce generalizable findings. This research is interested in acquiring detailed and in-depth information from the study participants that can produce understanding, inform policy and generate recommendations to help address the dark sides of sand and gravel winning and also to consolidate the positive effects. Aside gathering information from the respondents, the quantitative component of this research also informed the data presentation, i.e., establishment of relationships between independent (e.g., distance to sand winning sites) and dependent variables (i.e., price per double truck load of sand) and quantification of the demographic characteristics of the study participants. Based on the goal of this study, convergent mixed methods research was the most appropriate design for this investigation. By this design, the researcher asked both qualitative and quantitative-based questions concurrently, analyzed each strand independently and merged the results for further analysis and interpretation that informed the discussions and conclusions drawn.

Key informant interview guides and questionnaires were enlisted to solicit responses from the different categories of the study participants. This paper also gathered images of sand winning

sites, burrow pits, and other associated socio-economic and environmental effects using photography and personal observations. The data collected were then analyzed through qualitative thematic development and descriptive statistics using Microsoft Excel.

Findings

The result section is organized into socio-economic and demographic characteristics, reasons for engaging in sand and gravel mining, environmental and socio-economic effects of sand and gravel winning, and how sand and gravel mining can be conducted safely and sustainably.

Socio-economic and Demographic Characteristics of the Study Participants

The study participants cut across varied categories of stakeholders in the sand and gravel winning value chain. They include tipper truck drivers, sand and gravel winning contractors, sand loaders, landowners/landlords, sand and gravel winning regulators and other stakeholders (Figure 2). Out of the 63 key informants and survey respondents, sand loaders were in the majority (16), followed by tipper truck drivers (9), and truck owners (7). Male participants were 59 (94%) with only 4 (6%) females from Danko who were collecting rent on behalf of the landowners. Detailed information regarding the types of study participants and the associated frequencies can be seen from Figure 2.

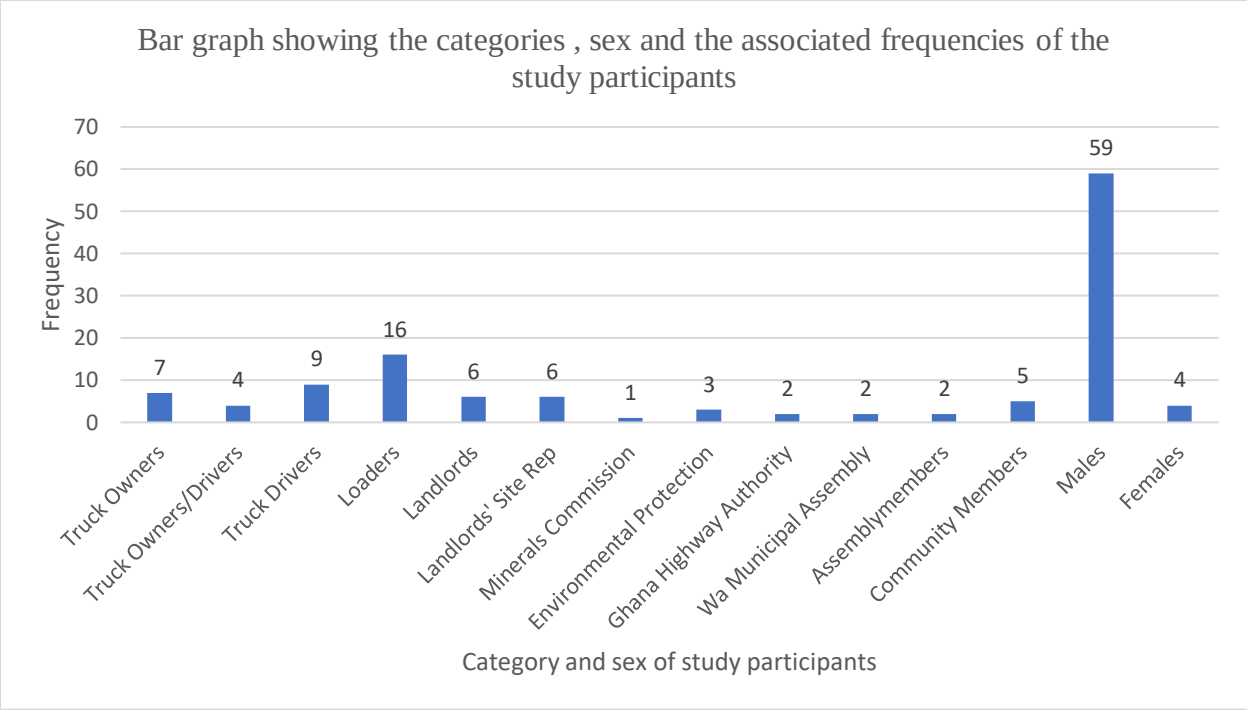

Figure 2: Categories and sex of the study participants
Source: Field data, 2019

Age Distribution of the Study Participants

Majority of the study participants fell within the 31-40 (26) age bracket. This was followed by those in the 21-30 (23) age group and less than 20 years (7) (Figure 3). This implies that it is mostly the youthful segment of the population that engages in sand and gravel winning activities.

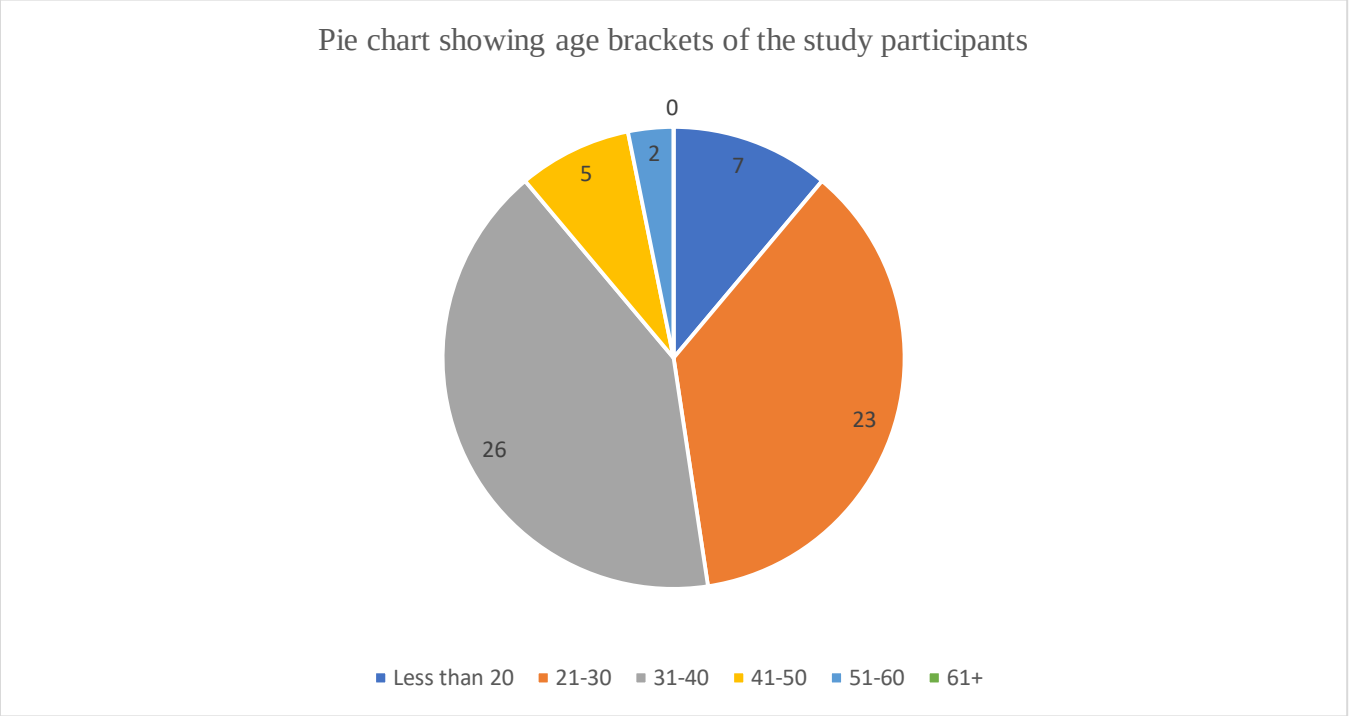

Figure 3: Age distribution of the study participants
Source: Field data, 2019

Educational Levels of the Study Participants

The study participants had formal, no formal, and non-formal educational backgrounds. Those with no formal education were in the majority (29%), mostly sand loaders. This is not surprising because one does not need any special skill to be in the sand and gravel winning business in Ghana, especially the sand loaders except those in the regulatory stream (e.g., EPA, Minerals Commission, and GHA Staff). Also, these sand loaders without any form of formal education revealed that sand and gravel winning is their main source of livelihood since it is difficult to get any meaningful employment without an appreciable level of education. This was followed by those with primary education (19%), tertiary education (17%), middle/JSS (16%), Secondary/SHS (11%), and non-formal education (8%). The eleven (11) participants with tertiary qualification were mostly staff

of the sand/gravel winning regulatory agencies, i.e., EPA, MC, GHA, WMA and the three (3) sand/gravel winning contractors (Figure 4).

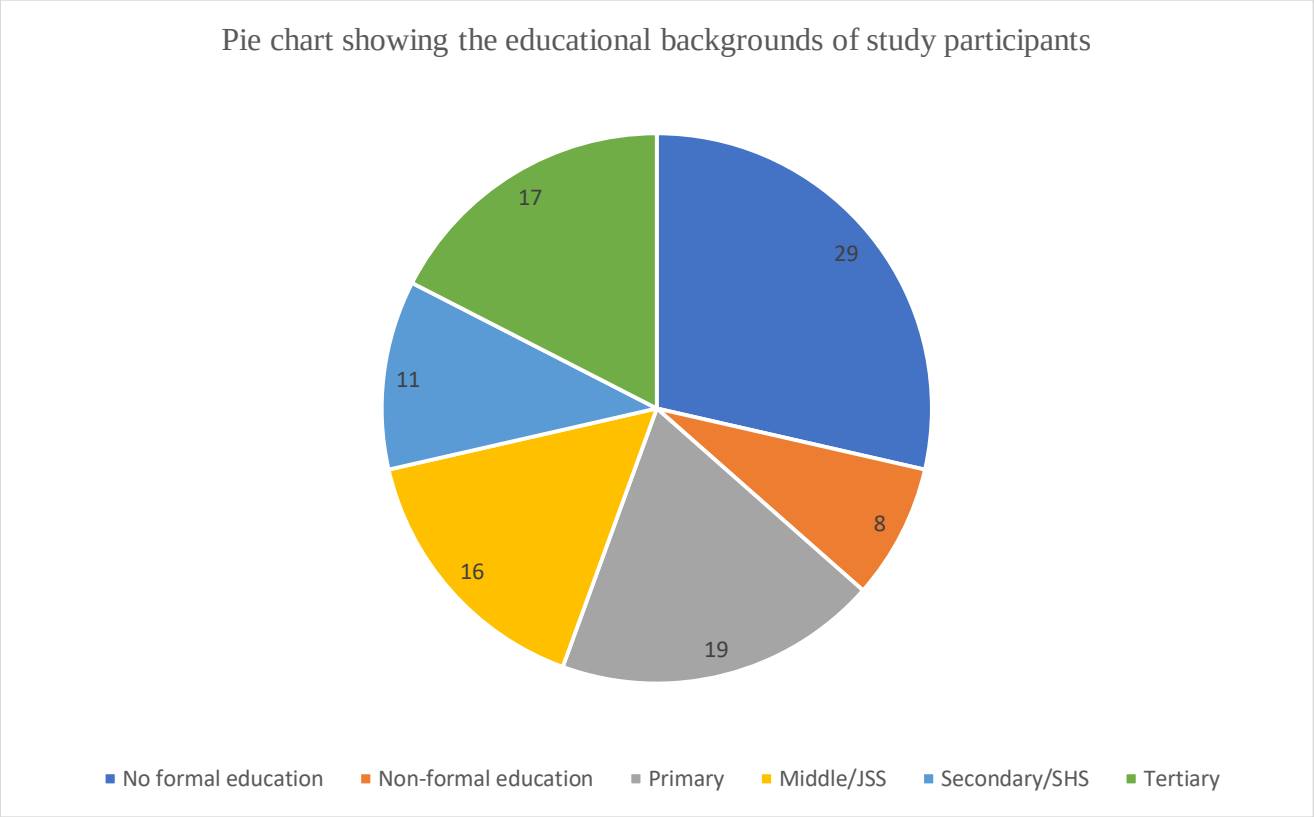

Figure 4: Educational background of the study participants
Source: Field data, 2019

Trips of Sand Load and the Associated Charges

Trips of sand load per day and the associated charges had implications for the environment, profitability, and livelihoods of stakeholders in the sand winning industry. The study, for instance, found relationships between the number of trips of sand/gravel loaded and carted/day, price /load, and rent landowners charge/load (independent variables) on the one hand and the socio-economic and environmental effects of sand/gravel winning (dependent variables) on the other hand. Peprah's work of (2013) revealed similar trends. The study participants were specifically asked questions on the independent and dependent variables enumerated above. In response, the key informants and questionnaire respondents gave varied answers. For instance, the number of trips

per day as reported by the study participants ranged from 3-11 with price per double load between GH₵ 160- GH₵ 280.* It was also revealed that cost per/trip is a function of the distance travelled to fetch sand/gravel and the bargaining power of the buyer. It was again reported that sand loaders and landowners charged GH₵ 40 and GH₵ 5-20 /double load, respectively (Table 1).

Table 1: Number of trips of sand load and the associated charges

Description of activities	Number of trips, price and charge/trip
Number of trips/day	3-11
Price/double load	GH₵ 160-280
Landlords' charge/double load	GH₵ 5-20
Sand loaders' charge/double load	GH₵ 40

***At the Exchange Rate of USD 1 to GH₵ 5.10**
Source: Field data, 2019

Sand and Gravel Winning Communities

The study was also interested in finding out the communities where sand winning activities are dominant since this has implications for the communities' welfare and environment. It is evident from Figure 5 that sand and gravel winning communities are dotted around the Wa Municipality. Majority of the key informants and survey respondents (19%) mentioned Danko as the most important source of sand and gravel. This was followed by Tanina (10%), and Nakori (9%). The remaining sand winning communities can be seen in Figure 5.

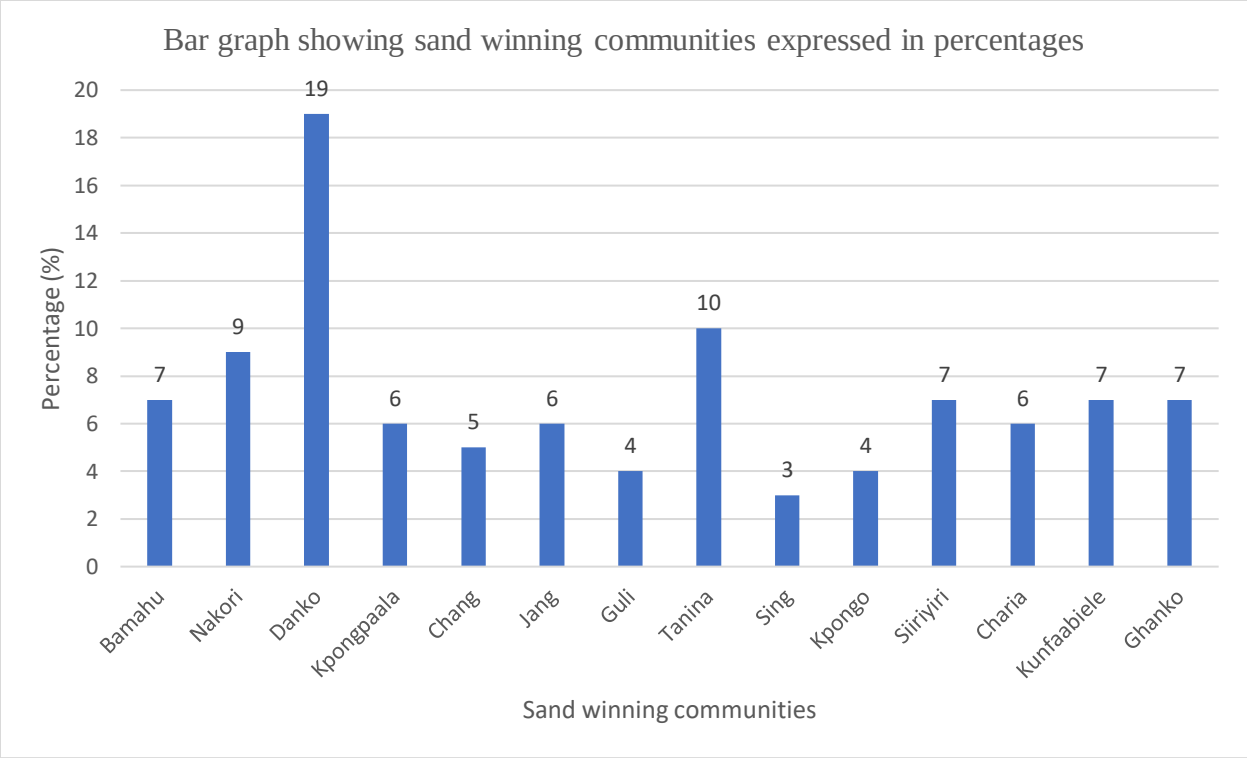

Figure 5: Peri-urban Wa sand and gravel winning communities
Source: Field data, 2019

Reasons for Engaging in Sand and Gravel Winning Activities

Objective one sought to explore the reasons why sand and gravel winning have been increasing over the years in the UWR, especially in the Danko community. In response, the study participants assigned the following reasons as captured in Table 2. For example, all the 63 (100%) study participants identified sand and gravel winning as a source of livelihood/employment for those involved in this small-scale industrial mining practice, whereas 61 (97%) of them attributed it to the increased demand for housing in urban Wa and its environs. The picture portrayed above is captured in Table 2.

Table 2: Reasons for engaging in sand and gravel winning activities

Reasons	**Frequency**	**%**
To meet the demands for increased housing needs due to increasing population and the accompanying urbanization	61	97
To meet the demands of the proliferation of institutions of higher learning and other associated infrastructure	40	65
To supply gravel materials for improved road construction	60	95
Sand and gravel winning as a source of livelihoods/employment	63	100

Source: Field data, 2019

Effects of Sand and Gravel Winning

An analysis of the responses revealed that sand/gravel winning has both beneficial and harmful effects, as shown in Figure 6.

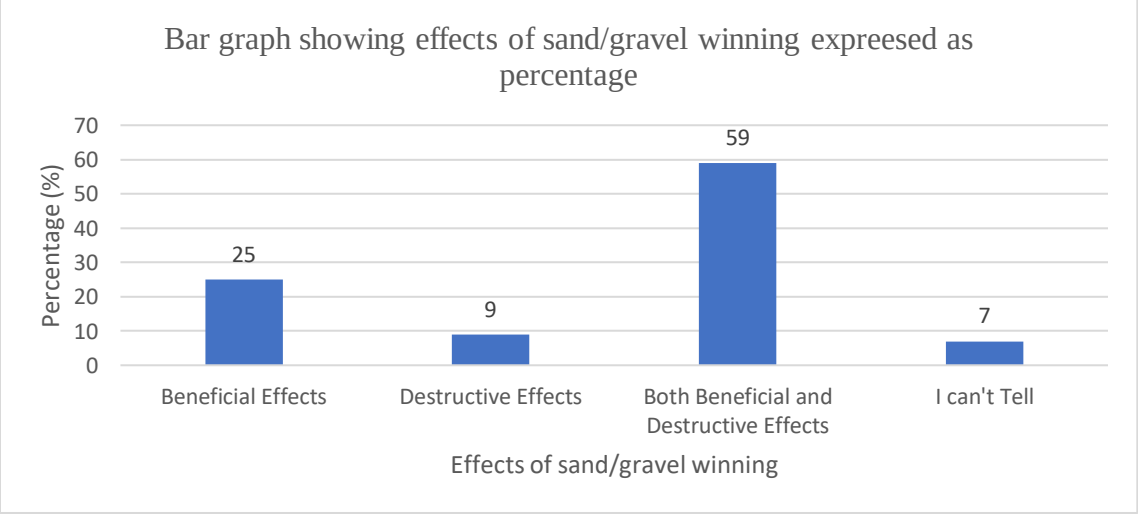

Figure 6: Effects of sand and gravel winning

Source: Field data, 2019

It is evident from Figure 6 that the general benefits of sand/gravel winning outweigh the negative effects. For instance, 25%, 9%, and 59% of the study participants indicated that sand and gravel mining was beneficial, destructive, and both beneficial and destructive, respectively. The beneficial effects were mainly socio-economic with the negative consequences being environmental. It is, however, important to note that the socio-economic and environmental effects are not mutually exclusive. The socio-economic benefits the study participants enumerated included provision of: (i) employment opportunities, (ii) income, (iii) raw materials for building and road construction, and (iv) pits as dugouts for various uses.

Since every coin has two sides, stakeholders in the sand and gravel winning value chain also reported adverse effects as follows: Land/environmental degradation, loss of agricultural lands, deforestation/de-vegetation, environmental pollution (air and water pollution), global warming/climate change, and sand/gravel pits breeding diseases. Other adverse consequences revealed were: the destruction of sacred groves, marginalization of women in sand/gravel mining activities, out-migration, generation of conflicts, and increasing school dropout rates, especially among the girl-child.

Strategies that Can Help Manage Sand and Gravel Winning-induced Challenges Sustainably

Since various stakeholders in the sand and gravel winning industry contribute to adverse environmental and socio-economic effects, it is the view of this paper that they must also be part of the solution. In this regard, the perspectives of the study participants were sought on sustainable and safe sand and gravel winning practices. The stakeholders in this small-scale industrial mining sector reported the following remedial and management measures: the involvement of all stakeholders in the discussion of sustainable sand and gravel winning practices; awareness creation about the adverse effects of sand/gravel winning and how they can be addressed; demarcation of suitable sites for sand/gravel winning activities; posting of reclamation bonds before commencement of sand and gravel winning undertakings; development of selected pits into standard dugouts (especially, through the government's flagship programme of One Village, One Dam (1-V-1-D), strengthening and resourcing the sand and gravel winning regulatory agencies to

enforce the necessary laws and regulations; payment of environmental taxes to the Wa Municipal Assembly, and provision of alternative livelihood opportunities. To most sand loaders, tipper truck drivers, and tally card recorders, sand and gravel winning is not a sustainable source of livelihood since these resources are non-renewable and demand for them is not only seasonable but can also be low at times.

Discussion of Findings

The Minerals and Mining Policy of Ghana (2014) reveals that sand and gravel winning activities form part of the small-scale industrial mining. According to this policy, small-scale mining, including sand and gravel winning, must be conducted in an environmentally, economically, and socially acceptable, responsible, safe, and sustainable manner.

Sand and gravel winning activities have been going on in Ghana since time immemorial and increasing in momentum in recent times in order to provide the needed raw materials for the building and construction sectors to meet the demands of the increasing population (Karikari, 2013; Jonah et al., 2015). Ghana's 2010 PHC revealed that 70.1% of buildings in the urban areas of the Wa Municipality came from cement blocks (i.e., using sand). The Wa Municipality recorded 106,214 people in 2010 out of the total Upper Region Region's population of 702,110 (GSS, 2014). This implies that about 15% of the population of the Region resides in the Wa Municipality, with 70.1% of its urban population occupying cement/blockhouses. It is, therefore, not surprising that some of the study participants said their involvement in the sand and gravel winning business is to support the development of the building and road sectors (**Plate 1**).

Plate 1: Displays the use of sand and gravel to support the building and road sectors.
Source: Photograph taken by the author, 2019

Sand and gravel extraction is expected to increase exponentially with the projected increase in the Wa township and Municipal population to 87,800 and 132,487 by 2020, respectively (GSS, 2014). This also suggests further urbanization and the accompanying population pressure on facilities such as housing and roads if substitutes for building and road construction materials are not found. This possible increase in demand can only be met by excavating more sand and gravel from peri-urban Wa, with the associated environmental and socio-economic effects.

The study participants, including staff of the regulatory agencies (EPA, GHA, urban roads, and WMA) were unanimous that these small-scale mining activities provided income and livelihood opportunities for those involved in the sand and gravel winning value chain. According to a male sand loader at a sand winning base station:

> *There are no jobs in the system, and some of us have decided to be in this sand winning business to be able to feed our families and also take care of ourselves. As I told you earlier, sand winning is my only source of livelihood [now]. I use the income earned to feed my family, pay my children school fees and still have small savings with the Credit Union at Old Mission [i.e., Wa Community Cooperative Credit Union]. Sand loading is not the best work for one to do, but it is better than stealing, armed robbery or even idling about. (26th February, 2019)*

This quotation demonstrates some socio-economic benefits of the sand and gravel winning industry in the Wa Municipality. Earlier studies widely corroborate these findings. For example, Agyemang (2010), Peprah (2013), and Narh (2016) all identified sand and gravel winning

undertakings as providing livelihood opportunities for sand loaders, truck drivers, truck owners, landowners with trickle-down benefits to food vendors and other auxiliary service providers. My interaction with some respondents, however, revealed that some sand loaders are mostly paid below the daily minimum wage despite the physical demands and the labour-intensive nature of sand and gravel winning. In the words of Abdul-Karim (a Pseudonym):

> *My brother, what can we do? There are no [decent] jobs. If you sit down, you can't get anything to feed your wife and children. That is why some of us are doing this job. We know our masters always cheat us, but what can we do? Those of us who haven't been to school have no choice. I hope you [refering to me] will use your position as a big man to find me a job at UDS as a labourer. (A male sand loader at Danko, 26th February, 2019)*

There was also a complaint from some Danko community members that sand and gravel winning activities are only benefitting those outside the Danko community and the few landowners residing in the community, whereas majority of community members are suffering from the adverse consequences of these mining activities. A community member described this situation as "an injustice being visited on the Danko community members." Aside the fact that no female was directly employed in the sand and gravel winning value chain by A & B sand winning contractor (a Pseudonym) except 2 females on the upstream sand winning sites collecting the rent on behalf of the landowners, only 3 out of the 16 sand loaders came from Danko contrary to the position of the Minerals and Mining Policy (2014) of Ghana and Small-scale Gold Mining Act (1989). These legal instruments emphasize the need for local content, i.e., making affected community members main beneficiaries of small-scale mining operations (e.g., provision of employment for sand winning community members). Peprah's (2013) sand winning and land degradation study in Wa expressed similar concerns when he reported that 48 truck drivers employed their sand loaders from Wa with only 2 recruiting their labourers from the sand winning communities.

It was also revealed that some community members are using some unreclaimed burrow pits as sources of domestic water supply. According to some respondents, water from such "dugouts" are used for dry season gardening, washing clothes and vehicles, building houses and drinking by livestock, especially during the dry season (**plate 2**).

Plate 2: Shows an abandoned gravel pit being used for dry season farming, washing of clothes and vehicles, and provision of water for the housing sector.
Source: Photograph taken by the author, 2019

Though a benefit to communities without conventional water sources, some residents of Danko interviewed said some of these water sources posed health hazards to them by acting as breeding grounds for mosquitoes (malaria) and also serving as death-traps for their animals and children (**Plate 3**).

Plate 3: Depicts stagnant water with the possibility of breeding water-related diseases like malaria and may also act as death-traps for children and animals.
Source: Photograph taken by the author, 2019

A staff of one of the sand/gravel winning regulators reported an incident where a school pupil was drowned in an abandoned burrow pit in his previous duty post. Peprah (2013) also reported both the beneficial and detrimental effects of some abandoned sand and gravel pits in peri-urban Wa that collected water for use in various ways.

Many studies also reported the role of sand and gravel winning in mobilizing tax revenues for local governments. For instance, Karikari (2013) captured in his study the payment of import and export duties from global trade in stones, sand, and gravel. In Ghana, Alhassan (2010), Karikari (2013), Peprah (2013), and Narh (2016) found sand and gravel winning contractors paying taxes to Municipal and District Assemblies. Even though Peprah (2013) reported payment of GH₵ 5/truck load of sand as tax to the Wa Municipal Assembly 6 years ago, all the participants in this study indicated non-payment of sand/gravel winning taxes to the Wa Municipal Assembly because the Assembly has stopped the practice of mounting revenue check points or barriers to collect taxes from trucks loaded with sand and gravel. A staff of the WMA confirmed this assertion. This constitutes revenue leakage to the Assembly, which could be harnessed to reclaim some of the abandoned burrow pits and finance other development projects.

Apart from the effects of sand and gravel winning described above, some study participants also identified a wide range of adverse environmental and socio-economic impacts associated with these small-scale mining activities. They specifically accused sand and gravel mining contractors of causing land/environmental degradation, air and water pollution, deforestation/de-vegetation, and loss of agricultural land (**plate 4**).

Plate 4: Portrays loss of agricultural lands to sand/gravel winning and destruction of economic trees.
Source: Photograph taken by the author, 2019

According to a farmer at Danko:

> *This 5-acre land you are looking at has been completely destroyed by a road contractor. They pushed aside the top fertile soil, scooped the gravel and left behind this wide pit. Even though this is our family farmland, we were never compensated. As you can see, my yam, bambara beans, and maize crops are planted on the edges around this 5-acre pit [on the topsoil the contractor pushed aside]. I have been doing this for the past ten years. If I were to use this pit [i.e., the land in its original form] to cultivate maize with all the required agro-inputs, I could harvest about 8 bags (i.e., about 50kg/bag) per acre. This means I am losing about 40 bags (2,000kg) of maize every year. (30th February, 2019)*

Some key informants and survey respondents were also concerned that sand and gravel winning activities were contributing to school dropout rates (especially the girl-child), forcing some farmers to migrate, generating conflicts among family members and between communities as well as marginalizing women in the industry. For instance, a farmer in Danko revealed that his family head clandestinely gave his farmland to a sand winner who destroyed the entire land, including all the economic trees such as shea and dawadawa trees, resulting in a fight between him and his elder brother, i.e., the family head. This compelled him to seek alternative employment as a night watchman in Wa to be able to feed his family. In his own words:

> *My daughter had to drop out of school because I could not sponsor my son and my daughter at the same time. So, I had to sacrifice my daughter's education since she will be married away, but my son may be here to take care of me at my old age.*
>
> (A male sand loader at a sand loaders waiting point, 30th February, 2019)

This is clearly the adverse effects of indiscriminate sand and gravel winning with gender ramifications. The sand and gravel winning literature are replete with such adverse impacts in some developing countries (Agyemang, 2012; Jonah et al., 2015; Baba, 2017). Alhassan (2010), for example, reported that sand and gravel winning activities in 28 communities in 10 Districts destroyed 187.5 hectares of farmland, including medicinal plants and economic trees such as shea and dawadawa trees in the Northern Region alone in 2010.

Conclusion and Policy Recommendations

This paper concludes that small-scale industrial sand and gravel mining has both beneficial and negative socio-economic and environmental ramifications. Some benefits of sand and gravel winning reported include provision of employment avenues, income, building and construction materials as well as serving as a source of livelihood to many stakeholders along the sand and gravel winning value chain. Despite the beneficial effects mentioned above, it was also revealed

that sand and gravel winning activities contribute to deforestation/de-vegetation, destruction of farmlands, and creation of borrow pits with stagnant water which may serve as breeding grounds for mosquitoes and other waterborne-related diseases.

The paper further concludes that sand/gravel winning in its current form is unsustainable. The study participants suggested that sand and gravel winning should be harnessed to continue to safely and sustainably promote the socio-economic development of Danko and its environs. To maximize the benefits of sand and gravel winning and at the same time minimize the negative effects, this paper recommends: (i) the sensitization and involvement of all stakeholders in the sand and gravel winning discussion, (ii) the enforcement of the relevant small-scale mining laws, regulations, and bye-laws by the Wa Municipal Assembly, EPA, and Minerals Commission, (iii) the selection and demarcation of suitable and regulated sites for sand and gravel winning by the Wa Municipal Assembly, EPA, and Minerals Commission, (iv) instituting measures to reclaim abandoned burrow pits as well as making sand and gravel winning contractors to post reclamation bonds for future rehabilitation of the associated burrow pits after decommissioning under the direction and supervision by EPA and Minerals Commission, and finally, (v) providing alternative livelihood opportunities for unskilled stakeholders in the sand and gravel winning value chain through government policy initiatives, such as Youth in Agriculture (YIA), One Village, One Dam (1-V-1-D), One District, One Factory (1-D-1-F), Planting for Food and Jobs (PFJs), and Rearing for Food and Jobs (RFJs).

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