



Research Article

Stone-Crushing Industry and Housing Demand in Pakistan

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Abstract: In developing countries, the stone-crushing industry is an important industrial sector, producing raw materials for construction activities. On the other hand, stone crushing has significant effects on the environment and human health. This study reviews the contribution of stone crushers in the construction sector and the degradation of environmental quality with special reference to Pakistan. For this purpose, literature from various journals was studied to collect the data. The results of the study revealed the increasing population in Pakistan, with an annual demand of 2.4% for accommodation and housing. While the country's construction industry accounts for 2.53% of Gross Domestic Product (GDP). The construction sector is reported to employ 7.61% of the population. In this regard, the China-Pakistan Economic Corridor (CPEC) has given impetus to the construction sector with an influx of infrastructure projects of power plants, dams, and highways. For such developmental activities, the role of the crushing unit is tremendous in providing the basic raw material for infrastructure. The literature revealed that the majority of stone-crushing units are operating illegally as 567 units have been declared hazardous to health and safety in the Peshawar region. Due to the lack of safety measures, workers involved in stone crushers were exposed to significant exposure to dust and noise, including respiratory (45.1%), skin (43.3%), eye irritation (17.8%), dyspnea (14.7%) and hearing (21%). It is therefore important to formulate a comprehensive, professional, and environmentally friendly management strategy for stone crushers. This study shows that regulatory measures are urgently needed to save the environment from pollution abatement. Among the underdeveloped countries, Pakistan is considered as one of the most highly populated countries. To respond to strong demographic pressure, the construction industry has become one of the main sectors in the country. Keeping this scenario, this study will help to know the availability and demand of raw materials for the construction industry. For a sustainable future, this study will propose a professional and ecological management strategy for stone crushers without affecting the economy and position of the stone-crushing industry.

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Introduction

The industrial sector is important for economic development, but it causes various environmental problems such as air pollution, water pollution, and soil pollution. Workers in industries have always faced problems of polluted environments and are exposed to dust and other pollutants. In the construction industry, stone crushing is an important industrial sector that produces crushed stones of different sizes according to demand. These crushed stones are like raw materials for construction activities like roads, highways, buildings, and canals, etc. The trend of stone industries is increasing day by day due to tremendous development/improvements in the construction industry. This sector helps to provide raw materials and jobs to skilled and unskilled people. Although mining and rock crushing is an important economic activity, its operations emit dust and pollutants into the environment. The size of the dust varies depending on the type of stone and its cutting treatment. Dust emissions can contaminate soil, air, water, and vegetation (Pal and Mandal, 2017).

The increase in demand for building materials has increased the demand for coarse and fine aggregates. The coarse and fine aggregates are crushed in a stone crusher. Stone crusher is a labor-intensive small industry that is manually operated. These crushers exist in almost every major city and town in the country. Because construction activities continue across the country. The stone crusher generates a lot of noise and dust particles in the environment, which can lead to pollution problems (Chougule *et al.*, 2017). Crushing units have their requirements as they need electricity to operate, an accessible location, and labor to operate them. In addition, transporting stone over long distances increases the cost of crushed stone products. For these reasons, stone-crushing units are positioned along the outskirts of major cities or large construction companies. Generally, stone crushers offer clusters of several units ranging from 5 to 50 in a cluster. The crushing units are placed close to the starting point of cold and wet materials such as riverbeds, stone mines, etc. These small industries are important socio-economically but pose health risks to workers that need to be controlled (Talwar *et al.*, 2017).

Stone crushing mainly generates Particulate Matter (PM) into the environment. Exposure to these particles can cause serious health effects, including respiratory

(45.1%), skin (43.3%), eye irritation (17.8%), and dyspnea (14.7%), and noise can cause hearing loss of around 21%. Dust emission also affects water quality by decreasing the level of dissolved oxygen and increasing the levels of calcium, magnesium, chloride, hardness, and total dissolved solids. Dust can impair visibility, and vegetation growth and affect the area's aesthetics (Divya *et al.*, 2012).

Among the developing countries, India is one of the leading countries having 12,000 stone-crushing units providing 500,000 jobs to people (Sheikh *et al.*, 2011). On the other hand, these crushing plants emit particles that not only disturb the quality of the environment but also affect human health. The transformation of rock stone into crushed material involves a series of steps (drilling, blasting, loading, hauling, crushing, screening, conveying, and transfer) which are the significant sources of dust emission (Sheikh *et al.*, 2011). The dust is made up of silica. Exposure to heavy dust from crushing units can cause respiratory, skin, and hearing problems, pneumoconiosis, silicosis, lung cancer, depression, blood pressure problems, and accidents. Workers working in stone-crushing units and nearby localities are at high risk of exposure to high concentrations of dust and noise that can lead to the manifestation of long-term diseases (Singh and Pal, 2010).

The literature revealed that dust from stone-crushing units in India reduced the growth of agricultural plants and crops and obstructed the aesthetic value of particular areas (Sharma and Kumar, 2016). Bell *et al.* (2001) reported that grinding dust also disrupts environmental and ecological systems. Ziaul and Pal (2016) that areas near stone mines and stone-crushing units are considered more vulnerable to dust. Saha and Padhy (2011) investigated dust and particulate emissions from stone crushers in India, which have significant impacts on the forest of that particular area. According to their research, plants located on the site closest to crushing activities had the greatest effects compared to others. They recommended that suppression measures are necessary for the survival of factories in this vital industrial sector. Similarly, another study also observed significant reductions in fruit/plant biomass due to dust emissions from stone crushers. The accumulation of dust in the soil changes its composition and makes the soil less productive to achieve good yield (Leghari *et al.*, 2018). Govindagoudar *et al.* (2022) studied the

harmful effects of stone-crushing plants on workers health due to dust emissions in India. The severity of health problems was observed due to the lack of health protection measures on the part of workers during the operation phase of the curdling factories. [Jain and Saxena \(2022\)](#) reported that stone-crushing plants are the major source of air pollution in India. The responsible source of air pollution is the emission of harmful gases and dust particles (PM) from vehicles and crushing plants into the atmosphere. These harmful materials make the air toxic to human health and degrade the quality of natural ecosystems. They identified a high concentration of Particulate Matter in the air, above the safety level of Indian national standards for various locations. [Pal and Manda \(2017\)](#) identified the adverse effects of stone-crushing units on water quality and vegetation cover in the Dwarka River basin, in Eastern India. They found that improper waste disposal by crushing plants led to increased sediment load in the stream, and deterioration of water quality with increased levels of total dissolved solids, pH, and turbidity. In addition, the catchment area is highly vulnerable in terms of vegetation cover due to dust emissions from crushing plants. A sprinkling of water sprays and plantation of necessary trees are recommended as mitigation measures near the stone-crushing units in India.

[Khan et al. \(2016\)](#) observed that stone-crushing units are the major cause of environmental pollution such as air and noise pollution in the area of Sargodha district, Pakistan. They further investigated that polluted air and excessive noise lead to health problems among workers in this particular area. The majority (945) of workers were not covered by health measures and were directly exposed to emissions from stone-crushing plants. [Hafeez \(2018\)](#) reported a significant number of worker losses due to diseases caused by dust in stone-crushing factories in the Taxilla region of Pakistan. [Shams et al. \(2024\)](#) reported chronic exposure of workers at stone-crushing plants targeting liver and kidney organs and associated skin and respiratory system complications observed in Charsadda and Mardan regions, Pakistan. This study is supported by another study conducted by [Ilahi et al. \(2012\)](#), who reported liver and kidney exposure among stone-crushing factory workers in the Swat region of Pakistan. Further, [Anees et al. \(2023\)](#) reported the environmental and health effects of stone-crushing plants in Abbottabad district, Pakistan. This area is a hub of stone-crushing

plants without any proper sanitation measures. They observed that low agricultural productivity, loss of biodiversity, land degradation, degradation of water and air quality, socio-economic conflicts, and serious health problems occur with stone-crushing plants. They further studied the severity of these effects in terms of dust, noise, and water pollution.

To execute the development infrastructure projects, the procedure for the raw material is quite simple like quarrying and stone crushing to meet the demands. Accelerated construction and development activities have put pressure on natural resources. To meet the demands of infrastructure projects, this pressure has become increasingly strong in recent years ([Al-Awadhi et al., 2013](#)). The Environmental Impact Assessment (EIA) is a detailed study of development projects related to a better and safer life. It is a strategy to measure and remedy the negative impacts of industrial activities on the environment. This assessment strategy ensures a balance between environment and development and is important for better environmental planning that can help to implement the idea of sustainable development ([Al-Awadhi et al., 2013](#)).

In Pakistan, stone crushing is a dominant but environmentally unorganized sector. It involves various environmental impacts of air, water, soil, and noise pollution. Stone-crushing units are placed in mountainous areas where stone availability is easy. These crushing units provide basic materials for infrastructure such as buildings, bridges roads, etc. Besides the production of construction materials, these units are a source of income for the local population ([Khan et al., 2016](#)). Pakistan is in 5th most populous country in the world holding 220 million people. This population consists of more than 60 million strong labor force ([Kayani, 2021](#)). Pakistan is considered among the top leading countries in terms of construction. Now this raises various questions:

- How many houses are required by the population of Pakistan?
- Why stone crusher is needed in Pakistan?
- What is the status of construction in Pakistan?
- How many construction industries will be enough to produce raw materials?
- How many houses are required and how can the stone crushers be environment friendly?
- These are a few questions that need to be addressed in this study.

Materials and Methods

To find suitable answers to the above-mentioned questions, literature was studied to know the current status of the construction industry in Pakistan with special reference to stone crushers. Secondary data from relevant research articles and reports were collected for discussion.

Discussion and analysis

The crushing unit is considered a small-scale industry intended to employ skilled and unskilled people. However, these units exert environmental pressures in terms of pollution and health risks. To understand the nature of the stone-crushing industry, the current situation in Pakistan is discussed in this article with the number of housing projects in terms of availability of materials, population growth patterns, and the role of stone-crushing plants in the economic and social development of the country.

Status of housing in Pakistan

Houses are considered necessities of life. In Pakistan, this need arises with the increase in the number of people. The current demand for housing is 11.4 million, this shows that 1/3rd of the population has no place to live. About 30 million of the current population have enough land to set foot on, but they don't have enough houses to live on. The private sector plays a key role in providing housing, but the price rate is too high and not affordable for everyone. Only first-class people can take advantage of this opportunity (Kayani, 2021).

The situation of house shortage is not new in Pakistan. This is a crisis present all around the world. Pakistan has a huge population growth record with 207.7 to 220 million from 2017 to 2020. The contribution of the rural population is about 2.7% per year. These numbers show that we are growing on a large scale with other necessities such as food, clothing, and shelter which are not checked. It is estimated that 34.2 million houses are required by the population of Pakistan (Figure 1A). Provincial-wise, the demand is recorded as 19.2M in Punjab, 8.6M in Sindh, 4.6M in KP, and 1.6M in Baluchistan (Figure 1B). While the available land is not enough to support the demand for houses throughout the country.

According to population, the number of housing required by the urban population is around 350,000

units per year in Pakistan. In these, the lower-income groups get 62%, the lower-middle-income groups get 25%, and the upper-class and middle groups get 10%. Among these groups, the low-income group is the most vulnerable part of the society that does not have stable or sufficient assets to negotiate bank loans. It is therefore difficult for these groups to build their own houses and therefore spend the majority of their savings on building houses. The investment in the construction of 5-10 marla houses is given in Table 1. The calculation for a normal-sized house required a lot of money which is beyond the income level of a middle-class family. Therefore, majority of the people spend their whole life to collect money to build a house. To help the people, the current government has launched an initiative called "Naya Pakistan Housing Scheme" which will build up to 5 million houses. To reduce the need for one million inhabitants, but such an amount is not enough to stop the growing need for total housing of more than 10 million (Kayani, 2021).

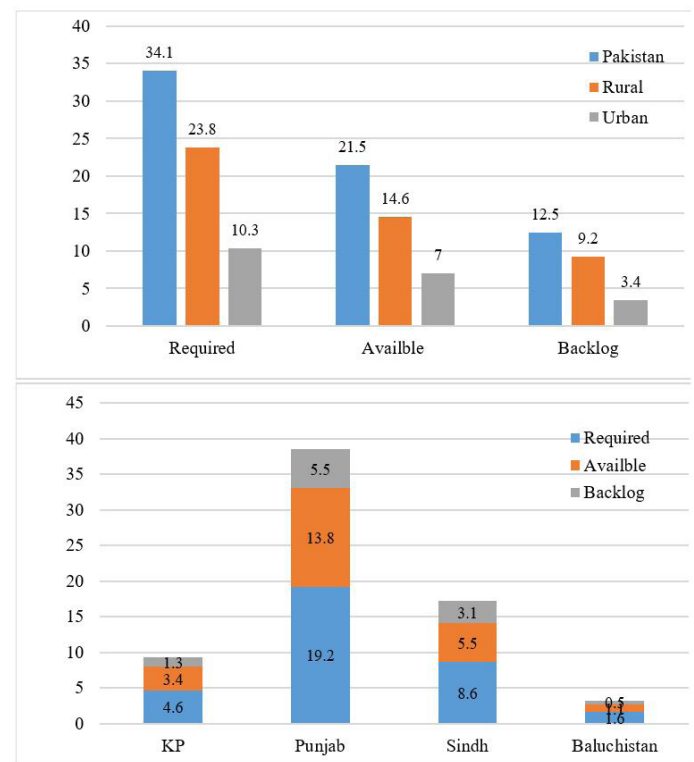


Figure 1: (A) Housing needs across Pakistan (millions). (B) Housing needs across Provinces (millions).

Source: Kayani, 2021.

Status of cement production for construction in Pakistan

In Pakistan, total cement production reached a record of 5.7 million tonnes in October 2020 (All Pakistan Cement Manufacturers Association). This is around 15% from last year and 10% up to September 2020. This figure shows 103% of the installed capacity of the

Table 1: Cost and quantity of material required for construction of house.

Item	Grey structure cost of 10 marla house			Grey structure cost of 5 marla house		
	Quantity	Rate/PKR	Cost/PKR	Quantity	Rate/PKR	Cost/PKR
Bricks, sand, crush & rori			1,437,000			823500
Bricks Awal	90,000	11.5	1,035,000	50,000	12	600,000
Sand	7000	20/c.ft	140,000	3150	20/c.ft	63,000
sand/Plaster	1200	35/c.ft	42,000	700	35/c.ft	24,500
Crush/Lender	1600	75/c.ft	120,000	900	80/c.ft	72000
Crush/Floor	1000	65/c.ft	65,000	600	65/c.ft	39,000
Rori	-	-	35,000	-	-	25,000
Cement, Kassu & Rebar			1,006,000			802,625
Cement	800	495/bag	396,000	525	645/bag	338,625
Rebar	5 ton/5000 kg	105/kg	525,000	3 ton/3000kg	138/kg	414,000
Kassu	-	-	85,000	-	-	50,000
Labour			1,237,500			770,250
Labour	3300	375/sq.ft	1,237,500	1975	390/sq.ft	770,250
Plumbing and wiring			250,000			165,000
Plumbing	-	-	135,000	-	-	115,000
Wiring	-	-	115,000	-	-	50,000
Grills, gate & chougat			237,000			196,000
Chougat steel	-	-	76,500	-	-	60,000
Grills, gate & chougat	-	190/sq.ft	85,500	-	220/sq.ft	66,000
Gate	-	800/sq.ft	75,000	-	900/sq.ft	70,000
Others			53,000			96,500
Termite spray	-	-	35,000	-	-	19,500
Tank	-	-	18,000	-	-	12000
Total cost			4,220,500			2,788,875

Source: Kayani, 2021.

cement industry in Pakistan, consisting of 25 industries producing a total of 69 million tons of cement and 66 million tons of clinker. Progressive construction work is growing rapidly throughout the country. In this regard, people could build houses of their choice under the PM-Naya Pakistan housing project by giving 30% billion subsidies to major construction projects. These reasons have increased the demand for cement which has increased the selling prices on the other side. The production capacity of Pakistani cement industries tripled (15 to 45 million tons) from the 1990s to the 2000s (Profit, 2020). Pakistan tops the global rankings for increasing the level of cement production. In this regard, it is reported that Pakistan will become the 6th largest country in the world by 2030 (Figure 2). In this race, Pakistan will replace Japan which is among the top 10 cement-producing countries in the world. Cement consumption is an important indicator of the development process and economic growth. Due to high consumption, the sale

rate of cement increased to 9.2%. Pakistan's cement industry has upgraded its production capacity by 59.5 million tonnes in anticipation of future infrastructure demands (Figure 3). It is estimated that this production capacity will be increased to 85 million tonnes, or 2% of world cement production by 2030. On the other hand, sales prices are expected to increase by 70% in the coming years (Haq, 2019). Other countries such as China are considered the top cement-producing countries with a 35% decline, followed by India with 16% globally by 2030. Pakistan faces a deficit of about 10 million housing units which is growing at the rate of 0.35 million per year. Under the Naya Pakistan housing program, about 5 million units to facilitate construction. A few years ago (2015), around 35% of households did not own a home and 47% did not have a retirement account. The sale price of cement in Pakistan will grow by 33% per year with a record of 4.4Mt to 5.7Mt by 2020 (Urdu Point, 2021).

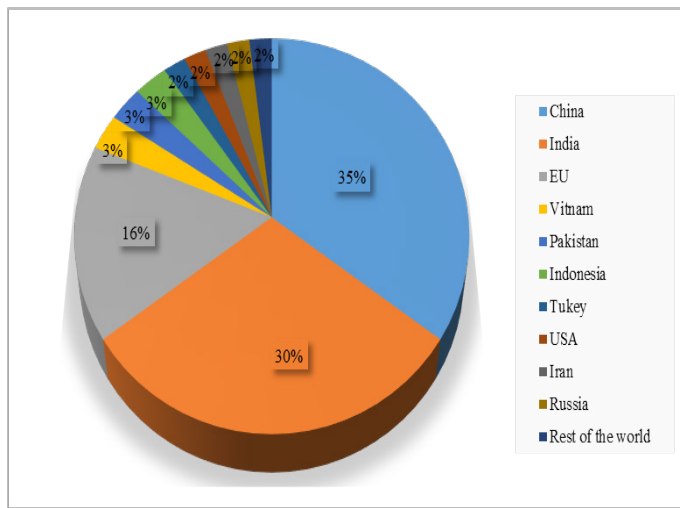


Figure 2: *Worldwide cement production forecast-2030.*
Source: Haq (2019).

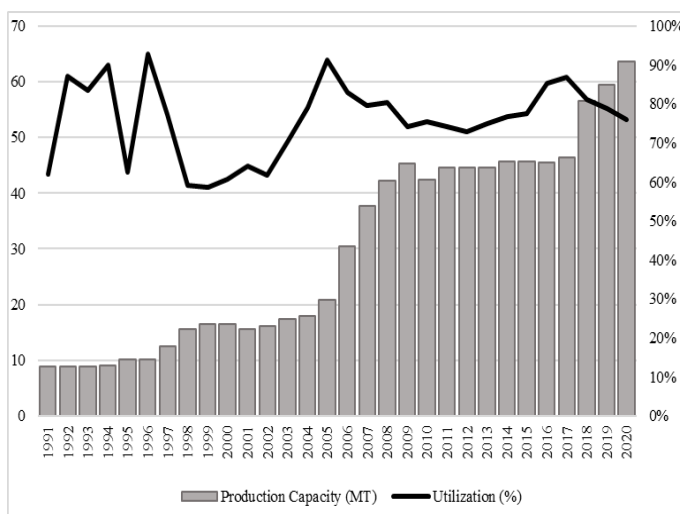


Figure 3: *Pakistan's cement production capacity.*
Source: All Pakistan cement manufacturing association.

Need for stone-crushing plants in construction

With the rapid increase in the construction industry all around the country, stone-crushing plants are installed to provide material for construction purposes. Pakistan is also leading in the installation of crushing units to fulfill construction needs. Crush stone is required for construction purposes as it is

considered important for cement preparation (Table 2). It is calculated that for 1kg cement, about 6kg crush stone is required. Besides providing the construction material, the crushing plants are threatened by environmental quality and they need the NOC from the environment department.

Unfortunately, the majority of stone-crushing plants are working on an illegal basis throughout the country. In the province of Khyber Pakhtunkhwa (KP), 853 crushing plants out of 900 are illegal. In the regions of Swat, Hazara, and D.I. Khan, 95% of the plants were observed to be functional without any NOC from the Environmental Protection Agency (EPA). For this reason, jobs, services, and health are threatened. In Malakand, only one plant is registered with the EPA out of 390, which is a major source of air pollution. Due to the air pollution problem, people in the region are facing respiratory and other health problems. The environment secretary has said that we will take strict action against all illegal and environmentally unfriendly grinding plants. He said that due to a lack of staff and authority, the environment department faces problems in taking action against illegal crushing plants. Only in 3 regions of KP province, more than 853 crushing units were declared as sources of air and water pollution. But no initiative has been taken in this regard. These crushing plants have been operating for a long time without any NOC. These plants do not pay any taxes, which represents a significant loss for the financial situation of the country. By the agreements, the government investigated 900 crushing units in KP, the majority of which were declared vulnerable to environmental quality. Likewise, thousands of crushing units operate in other parts of the province that are unsafe for health and the environment. Out of 929, 567 crushing units were investigated as being hazardous to the health of workers in other parts of the province.

Table 2: *Proportion of concrete mixes for construction.*

Concrete type	Proportion of mix	Nature of work
M5	1:5:10	Mass concrete for walls, foundation, footings
M7.5	1:4:8	Mass concrete and foundation of less importance
M10	1:3:6	
M15	1:2:4	For general works, slab, beams, columns, etc.
M20	1:1 _{1/2} :3	Water retaining structures, piles, and general structure
M25	1:1:2	Heavily loaded construction

Source: Urdu Point, 2021.

The inhabitants of the areas closest to the crushing plants are exposed to skin, allergic, and respiratory problems due to dust emissions from the crushing units. In the Hazara region, only 50 out of 126 units are registered with the EPA while in D.I. Khan, 25 out of 194 units are registered. 567 crushing units are declared dangerous for workers in the regions of Peshawar, Malakand, and Hazara. The number of unregistered and non-environmentally friendly units is much higher than the quantity mentioned. Due to staff shortages and its weak financial situation, the EPA is unable to approach these units. To deal with this, the Environment Secretary clarified that collaborative work is needed with the Department of Industries to take strict action against all such units.

The Supreme Court of Pakistan has issued a notice to the KP-Secretary Mineral against crushing plants in the Haripur district. The 3-member bench of the Supreme Court decided Rule 2 and Schedule IV of the KP-Power Crusher Act-2020 (KPK Act No-1 of 2020). In their decision, they said that all crushing plants in Suraj Gali (a rural area in the Haripur district) must comply with environmental standards. To comply with KP rules, these crushing plants are located at a distance of about 97 meters from the locality. According to KP rules, the limit for such facilities is approximately 300 meters in rural areas and 500 meters in urban areas. These plants pollute the air due to which the population suffers from cancers and respiratory problems (Urdu Point, 2021).

The crushing plants association and locality of Bara, Peshawar told in a press conference that if restrictions against crushing plants are not removed, we will not only boycott the polio campaign and local government but will close the Pak-Afghan highway. This press was joined by the National Council legends including Abdul-Ghani, Haji Ibrahim, Saddique Charagh, and others. They said that the government should stop our financial shootout. Instead of giving jobs to people affected by terrorism, the government is stealing their jobs. The government did not provide any relief to those affected before and after the terrorist operation. Our houses are still in poor condition. Businesses and jobs are gone. Our financial shoot is still going on. On top of all that, the government does nothing for us. Aren't we Pakistani? Crushing plants are a source of income and revenue generation and the majority of people were involved in this activity. But their closure snatched jobs from people. In this regard, we have

asked the officers concerned, but no action has yet been taken. Now we warn that if the government does not remove this penalty, we will take strict action.

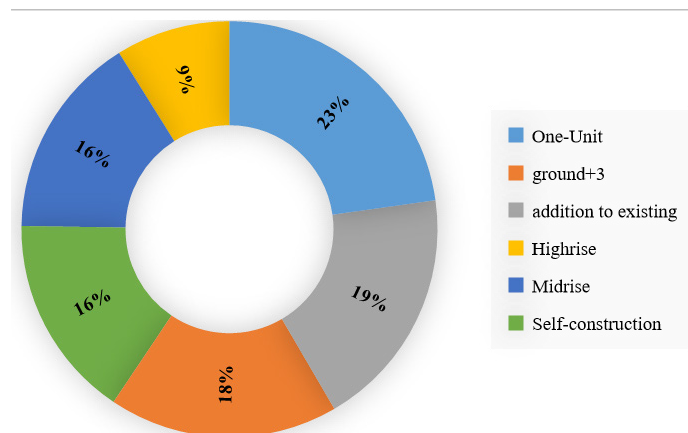


Figure 4: Proposed housing mix by Naya Pakistan Housing Scheme.

Source: Kiyani, 2021.

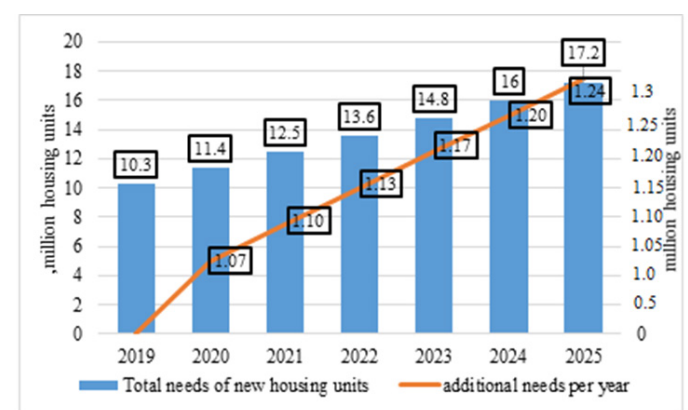


Figure 5: Future housing needs (million housing units).

Source: Kiyani, 2021.

Houses demands and needs under the Naya Pakistan housing scheme

To support a heavy population burden, the government is making serious efforts to provide them with housing at affordable prices. The Naya Pakistan is an affordable housing project that will help the poor and middle-class finance their own homes over 20 years by taking easy loans at the lowest interest rate of 5% per annum. In this system, 23% of individual housing and 16% of self-built housing are planned (Figure 4). According to the CEO of Lahore, Moazam Nawaz put his words in favor of the Naya Pakistan housing project. He said this project will not only revive the construction and real estate industry but will put the economy on the road with a quick recovery. This program is also useful for overseas Pakistanis as they will be able to build their own homes in Pakistan with funds from local banks. Apart from these benefits, there are certain limitations

Table 3: Environmental management strategy for stone crushing plants.

S. Pollution/ Impact problem		Mitigation measures
1 Air pollution	Emission of NO _x , and SO _x from generators.	-Stockpiles need to be covered with tarpaulin sheets and sprinkled with water spray. -Regular monitoring of crushing plants for clean in safe operation.
	Emissions of CO _x from vehicles.	Low-emission vehicles need to be used for the transportation of material.
	Dust emissions will add PM into the air during the crushing of stones.	-Installation of dust bag filters to prevent dust emission. -The height of stockpiles needs to be kept minimum and close to the consumption point to minimize dust emission.
2 Water pollution	Putting pressure on groundwater resources due to excessive withdrawal of water.	-Avoid using groundwater and prefer to utilize surface water. -Wastewater should be stored in pits for reuse in various construction activities and landscape works.
	Deterioration of surface and groundwater quality.	-Surface water should be reused for sprinkling. -The opening of the bore needs to be covered to avoid groundwater contamination.
	Disposal of waste into water bodies.	Adopt safe disposal of chemicals or any liquid waste (not near the water body).
	Chemical exposure to pollutants increases silting from surface runoff.	Adopt the Three R's principle (Reduce, Reuse, Recycle) to minimize water contamination.
3 Noise pollution	Communication problems and sleep disturbances among workers.	-Machinery and equipment should be properly tuned and lubricated. -The generator should be placed away from the working location.
	Hearing loss.	-Proper protective measures should be used by workers such as earplugs. -Sound barriers around the boundary wall are useful to minimize noise in the surroundings.
4 Solid waste	Improper disposal of solid waste may cause blockage of streams and contamination of lakes.	-Clean-in-place activities need to be adopted. -A proper waste management site plan should be made. -Installation of waste collecting bins at the working points. -Arrangements for regular collection and removal of garbage from the sites. -Organic waste should be composted in nearby agricultural fields. -The recyclable items should be collected and sold out. -The concerned department for solid waste management should be involved in the proper collection and disposal of waste.
5 Health and Safety	Health impacts include inhalation of dust and PM during crushing. Operation phase of the plants.	-The workers should be provided with first aid and should be cured during an emergency. -The contractor should ensure a clean and hygienic environment for working activities. -Drivers should be trained for safe driving to avoid any mishap. -Availability of protective measures to the workers like masks, gloves, ear plugs, etc. -Emergency plan and exit door. -Induction of training for the workers every month. -Strictly implementation of Environmental management plan by all workers.
6. Biodiversity	Loss of flora and fauna near the working sites by the workers and other inhabitants.	-Plantation plan for various plant species at the sites to enhance habitats for birds and other species. -Regular monitoring of hunting and shooting of birds, mammals, and other species near working sites.

Source: Anees et al., 2023.

of land and its use, money, and construction that need to be reformed. Under this project, applicants will be required to provide 10% of the loan in equity while the remaining 90% will be financed by banks. Over the past few years, a record rate of about \$10.3 million shortfall has been recorded to support the people of

the country. It is estimated that 17.2 million homes will be needed through 2025 (Figure 5). This is an increase of about 150% in demand for homes. This project has fixed 1.07 million units per year, but this is not fixed and can be increased to 1.24 million units per year (Kiyani, 2021). On the other hand, the private

sector contributes to making the country a real estate sector. The demand for houses can influence the needs of consumers in other sectors. GDP is also influenced by the real estate and construction sector. To meet the demands of the people, the Naya Pakistan housing program project is a gateway to help the poor and middle class in the country.

Health effects and environmental management plan of stone-crushing plants

This article studied that environmental pollution from stone-crushing plants can affect the health of workers with various diseases such as asthma, eye irritation, tuberculosis, and chest pain. In addition to these diseases, skin allergies constitute one of the major health problems reported among workers. As stone-crushing plants do not use any type of fuel, the uncontrolled fugitive dust emitted from these plants has a deadly effect on the workers and residents living around the crushing plants (Shiekh *et al.*, 2011). In addition, noise pollution is another significant impact of stone-crushing plants, causing hearing loss among workers (Table 3). The literature revealed that the majority of small and medium-sized crushing units were observed without any dust control equipment, which is a violation of environmental laws (Srivastava, 2023). The stone crusher sector is an obvious source of particulate matter (PM) which poses a major threat to public health. For this, stone-crushing plants must adopt safety measures, including protective measures in operating activities, dust pollution management, and monitoring measures by adopting an appropriate environmental management strategy for the areas where stone-crushing plants are located, listed in Table 3 (Anees *et al.*, 2023). Adoption of the proposed plan for effective management and implementation of mitigation measures will not only minimize negative environmental impacts but will also lead to the valorization of this small sector (stone crushing) as an emerging field of the construction industry. According to the Khyber Pakhtunkhwa Environment Protection Act, 2014 and the EIA Regulations, 2000, the IEE/EIA process is a legal provision. This law states that pollution resulting from any development activity is closely related to site allocation, type, and use of equipment, production process, and capacity building of workers. In Pakistan, very little information is currently available regarding stone crushing and the health effects associated with its emissions. Shortly, it is considered important to continue research to find appropriate management techniques to overcome

problems related to environmental health.

Conclusions and Recommendations

This study concluded that environmental components such as air, water, and soil can be affected during any construction and operation phase of a development activity. In the construction sector, stone crushing is an important industry in Pakistan, but it is neglected environmentally and socially. The trend of stone-crushing plants is growing nationwide, closely associated with the expansion of the construction sector, reflecting the increase in economic growth and resource consumption. Therefore, the stone-crushing sector is growing day by day, but the issues related to this sector are ignored, making sustainable utilization of existing resources impossible. Additionally, the majority of crushing plant workers are illiterate and need safety measures for their health. For this, if the environmental monitoring plan and management plan are followed, the negative impacts of the stone-crushing industry on natural resources and human health can be minimized in many cases. To guarantee environmental quality, health, and safety, it is strongly recommended to adopt the environmental management plan such as the plantation must be carried out within the framework of the project, natural resources must be used sustainably with a sustainable approach to development.

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Novelty Statement

This study is a step to raise public awareness and disseminate the culture of stone-crushing industry for its best facilitation and providing an environmental management strategy making sustainable utilization of existing resources.

Author's Contribution

All the authors contributed to the study. Nazish Huma Khan is the primary author, supervised by Dr. Mohammad Nafees. Dr. Tooba Saeed and Dr. Sarzamin Khan helped in data collection. Dr. Hazrat Hussain and Ms. Nida Naz helped in the compilation and writeup of the results.

Data availability

The data is original and has not been submitted to any other journal for publication.

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Conflict of interest

The authors have declared no conflict of interest.

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