

## ASSESSING THE IMPACT OF CONSTRUCTION INDUSTRIES ON RESIDENTS IN RESIDENTIAL AREAS OF KATSINA METROPOLIS OF KATSINA STATE

**Saminu Sani Bako<sup>1</sup>, Ibrahim Hamza Gambo<sup>2</sup>, Ilyasu Gambo<sup>3</sup>**

<sup>1</sup>Department of Quantity Surveying, Hassan Usman Katsina Polytechnic, P.M.B 2052, Katsina, Katsina State, Nigeria.

<sup>2</sup>Department of Maths and Statistics, Hassan Usman Katsina Polytechnic, P.M.B 2052, Katsina, Katsina State, Nigeria

<sup>3</sup>Department of Applied Chemistry, Federal University Dutsinma Katsina, Katsina State, Nigeria

E-mail Address: bSaminu@rocketmail.com

### ABSTRACT

The study investigates the impacts of construction activities on residents in the residential areas of Katsina Metropolis, Nigeria, examining environmental, social, and economic dimensions. The research addresses key issues faced by residents living near construction sites, including noise pollution, air quality degradation, traffic congestion, and safety hazards, which disrupt daily life and affect overall well-being. Through surveys and statistical analysis, the study reveals a significant increase in noise disturbances and air pollution, leading to a diminished quality of life, especially concerning respiratory health and concentration in daily tasks. Traffic congestion and safety concerns emerge as additional stressors, impeding mobility and fostering anxiety about potential accidents. Demographically, long-term male residents, primarily in densely populated apartment complexes, report heightened exposure to construction-related disturbances. The findings underscore an urgent need for targeted intervention by construction firms and urban planners to develop resident-centered mitigation strategies, including noise and air pollution controls, improved safety protocols and proactive community engagement. This study contributes essential insights to stakeholders aiming to balance urban development goals with residents' quality of life in growing Nigerian cities.

**Keywords: Construction; Industries; Residents.**

### 1. INTRODUCTION

Residential areas are designated spaces where individuals and families reside, seeking comfort, safety, and tranquility. The intrusion of construction activities into these environments can disrupt the delicate balance of daily life, posing challenges that extend beyond the construction site boundaries. Noise pollution, dust, air pollution, traffic congestion, and safety hazards are among the common issues faced by residents living near construction sites. The significance of this research lies in its potential to shed light on the complex interactions between construction industries and residential communities. By systematically evaluating the impacts of construction activities on residents, policymakers, urban planners, and industry stakeholders can make informed decisions to minimize negative consequences and maximize benefits. Urbanization has led to an increased demand for infrastructure development, resulting in numerous construction projects within residential areas. While these projects are essential for modernization and economic progress, they can also disrupt the daily lives of residents. Common issues include noise pollution, dust, traffic congestion, and safety concerns. These disruptions can affect physical health, mental well-being, and overall satisfaction with living conditions. The construction industry's influence on urban landscapes is undeniable, but it is essential to balance development with the well-being of residents. This research seeks to shed light on the often-overlooked impacts of construction on residential communities and to offer practical solutions for more harmonious coexistence. By addressing these challenges, we can promote sustainable development that benefits both the economy and the quality of life for urban residents.

#### 1.1 Environmental Impacts of Building Construction: A Comprehensive Assessment

Building construction plays a critical role in the growth and development of a nation, offering shelter one of life's basic necessities for both citizens and non-citizens (Ahmed, 2012). However, the construction process is associated with various environmental impacts (Amit & Ipshita, 2014; Vivek et al., 2016; Aremu et al., 2015). These impacts arise primarily from the dust, noise, raw materials, and energy consumption involved in construction activities. According to Selvakumar and Jaykumar (2016), the design, construction, maintenance, and use of structures result in both direct and indirect environmental effects, including energy consumption, ecological degradation, visual disruption, and material wastage. Jigah et al. (2016) emphasized the importance of identifying potential environmental impacts in order of severity, to minimize the adverse effects of construction projects. The extent of environmental harm varies across industries, but the built environment is widely recognized as one of the largest contributors to greenhouse gas emissions (UNEP, 2009). Over the life cycle of a building, the cumulative environmental impacts may rival those generated during the initial construction phase (Deng et al., 2014).

The construction sector is responsible for a significant proportion of environmental damage in developed nations, largely due to the materials and energy used during construction (Patel, 2014). This study aims to identify the gases emitted during construction, the various environmental impacts of construction activities, and the factors that contribute to these negative effects. Additionally, the research seeks to explore methods for controlling and mitigating the environmental consequences of building construction.

### 1.2 Categories of Environmental Impacts from Construction Activities

Chen et al. (2000) identified seven major types of pollution and hazards stemming from construction activities: dust, harmful gases, noise, solid and liquid wastes, fallen objects, ground movements, and other related risks. Expanding on this, Chen et al. (2005) categorized construction impacts into eight areas: soil and ground contamination, underground water contamination, construction and demolition waste, noise and vibration, dust, hazardous emissions and odors, wildlife and natural feature disruption, and archaeological impacts. Cole (2000) emphasized that the environmental impacts of construction processes encompass resource usage, ecological loads, and human health concerns. March (1992) noted the construction industry's environmental footprint across several domains, including ecology, landscape, traffic, water, energy, timber consumption, noise, dust, sewage, and health and safety hazards. Shen and Tam (2002) focused on the extraction of environmental resources like fossil fuels and minerals, the extended use of general resources such as land, water, air, and energy, as well as the production of waste that requires land for disposal. Additionally, they highlighted the pollution of the environment through noise, odors, dust, vibrations, chemical and particulate emissions, and waste production. Cardoso (2005) identified several typical negative impacts of construction activities, including waste generation, mud, dust, soil and water contamination, damage to public drainage systems, destruction of plants, visual impacts, noise, traffic congestion, parking shortages, and damage to public spaces. From this overview, it is clear that there is no single unified approach to categorizing the environmental impacts of construction in the literature. The Eco-Management and Audit Scheme (EMAS) regulation, as referenced by Gangolles (n.d.), provides a standardized and comprehensive list of environmental aspects that cover most of the previously mentioned impacts. EMAS initially identifies nine key environmental factors: (1) emissions to air, (2) releases to water, (3) waste management (avoidance, recycling, reuse, transportation, and disposal of solid and hazardous wastes), (4) land use and contamination, (5) use of natural resources and raw materials (including energy), (6) local issues (noise, vibration, odor, dust, visual impacts), (7) transport issues, (8) risks of environmental accidents and incidents, and (9) effects on biodiversity. However, the environmental impacts identified by EMAS had to be adapted to construction processes, which led to a detailed preliminary analysis using a process-oriented approach (Zobel & Burman, 2004). The EMAS environmental impacts were then analyzed comprehensively for the entire construction process.

### 1.3 The Economic and Environmental Impact of Construction Waste

The economic development of any nation is closely tied to its construction sector (Husnain et al., 2017). This industry is not only a major source of employment but also contributes significantly to economic growth, serving as a foundation for other industries (Ofori, 2015; Venugopal et al., 2020). Its role in socioeconomic development extends beyond its direct contribution to national output, encompassing large-scale building, civil, and heavy engineering projects that drive national progress (Lopes et al., 2011; Akadiri et al., 2012; Tafesse, 2020). In developing nations, construction accounts for 80% of total capital assets, 10% of GDP, and over 50% of investments in fixed assets (Jekale, 2004). However, the built environment consumes vast amounts of natural resources and is responsible for generating a considerable proportion of global solid waste (Merino et al., 2010; Hakan et al., 2012; Da Paz, 2018; Muhammad et al., 2020). Construction waste is increasingly generated due to various factors (Baniyas et al., 2011; Ignacio et al., 2011; Ajayi et al., 2017), with the industry contributing a significant volume of overall waste (Luangcharoenrat et al., 2019; Tafesse and Adugna, 2021). In fact, construction waste constitutes roughly one-third of all global waste (Gottsche and Kelly, 2018), with 10–30% of waste being sent to landfills worldwide (Polat et al., 2017). Civil works and building construction consume 60% of raw materials, with building projects alone accounting for 40% of this consumption (Ignacio et al., 2011). The construction sector is also responsible for generating 35% of the world's waste, using 35% of global energy, and contributing 40% of carbon dioxide emissions (Solís-Guzman et al., 2009; Yuan et al., 2012; Luangcharoenrat et al., 2019). Given these challenges, the issue of construction waste has attracted increasing attention from both industry professionals and researchers (Tam, 2008; Lu and Yuan, 2011; Adewuyi and Odesola, 2016). Recent studies highlight the negative impacts of construction waste on projects, the environment, and the economy (Eze et al., 2016). The waste generated from construction activities affects energy efficiency, sustainability, and environmental health (Castellano et al., 2016; Ghaleb et al., 2021). Additionally, urban sustainability, economic values, environmental safety, and the well-being of communities are deeply impacted by construction waste (Eze et al., 2016; Laborel-Preneron et al., 2016; Aslam et al., 2020). These impacts span three crucial areas: environmental, societal, and economic (Olanrewaju and Ogunmakinde, 2020; Rodríguez et al., 2020). On the social front, construction waste poses health risks due to various

diseases, creates traffic congestion, and contributes to flooding by clogging drainage systems (Nguimalet, 2007; ELARD and GAA, 2009; Aboginije et al., 2020). Environmentally, the waste generated by construction leads to soil and water contamination, depletes natural resources, and contributes to landscape degradation (Oladipo and Oni, 2012; Edwards, 2014; Mydin et al., 2014; Milad and Sungjin, 2020). Economically, construction waste increases project costs, as it is estimated that 30% of material costs contribute to project overruns (Eze et al., 2016; Olusanjo et al., 2014). Moreover, approximately 10–15% of purchased materials for construction projects are wasted (Wong and Yip, 2004), making construction waste a key factor in economic loss and business failure within the industry (Enshassi et al., 2006; Yeheyis et al., 2013). Although construction waste is an issue globally, it continues to be a challenge for both developed and developing nations (Kabirifar et al., 2021). Low and middle-income countries in particular struggle with the management of construction waste (Wu et al., 2016; Ghaleb et al., 2021). The issue is not confined to the construction sector alone but extends to the entire economy of affected nations (Jawad and Omar, 2016). As awareness grows, construction waste is increasingly recognized as a major obstacle to achieving sustainability (Al-Hajj and Hamani, 2011; Anderson and Thornback, 2012), prompting various organizations to prioritize sustainability in their agendas (Narcis et al., 2019).

#### **1.4 Managing the Adverse Impacts of Construction Projects on Urban Communities a Framework for Effective Project Management**

The construction industry is essential for meeting human needs, and construction activities, particularly in urban areas, are unavoidable (Gilchrist and Allouche, 2005). These projects, however, often become significant sources of disturbances in cities. Construction activities can negatively impact the surrounding ecological, sociological, and economic systems (Shen et al., 2010; Teo and Loosemore, 2011). Unfortunately, project teams frequently neglect these impacts on external stakeholders during the management process, which can lead to resistance from affected communities (Teo, 2009). Such resistance, often stemming from the "Not in My Backyard" (NIMBY) syndrome, can manifest in protests, legal actions, or pressure on government agencies, potentially causing project delays, budget increases, and additional costs (Burningham, 2000; Olander and Landin, 2008). To mitigate these conflicts, project management teams must address the nuisances caused by construction activities. However, many teams inadvertently exacerbate conflicts due to the absence of theoretical frameworks to guide them (Teo, 2009). Gilchrist and Allouche (2005) suggest using a "construction impact assessment" model to protect both the natural and built environment. Their study identifies several adverse impacts, but research on social costs and environmental impact assessments remains limited. One flaw in social cost studies is the assumption that all negative impacts affect the community equally, leading to poor resource allocation. Environmental impact assessments often overlook community perceptions, although considering local views is crucial for prioritizing the most significant nuisances.

This study aims to assess the impact of construction industries on residents in residential areas of Katsina state Through a questionnaire to rank these impacts through descriptive analysis and a criticality index. The results provide a roadmap to guide construction project management in effectively addressing the concerns of neighboring communities.

#### **1.5 The Environmental Impact of Construction Activities a Growing Concern**

Environmental degradation has become a global priority, gaining significant attention at local, national, and international levels (Bentivegna et al., 2002). Langston and Ding (2001) argue that the world is facing an environmental crisis, exacerbated by population growth and the pursuit of development, particularly in the built environment. This has led to issues such as ozone layer depletion, global warming, resource depletion, and ecosystem destruction (ibid). As a result, the construction industry has come under scrutiny for its substantial environmental impact, as its activities affect the environment throughout the life cycle of a development from initial site work, through construction and operational periods, to demolition. Although the construction phase is relatively short compared to the operational life of a building, it has profound environmental effects. Increasing concern surrounds the impact of construction on both human health and the environment. While construction projects contribute to economic and social development by improving living standards and quality of life, they are also linked to environmental degradation (Azqueta, 1992). In Ghana, as in other developing countries, the construction industry's focus is predominantly on economic growth and improving quality of life, often at the expense of environmental protection. According to Ghana's Statistical Service, the construction industry contributed 19.2% to the nation's GDP in the third quarter of 2012, making it the second-largest sector in the economy. While this highlights the industry's role in driving social and economic progress, its negative environmental impacts are largely overlooked.

Beyond the construction of buildings such as homes, hospitals, and schools, the industry also encompasses civil engineering projects like roads, bridges, and communication infrastructure all of which place considerable pressure on natural resources. The environmental significance of this pressure is heightened when depletable and non-renewable resources are involved, putting the construction industry in direct conflict with environmental sustainability. Despite the

industry's benefits, unsustainable design and construction practices, along with constant environmental degradation for construction purposes, persist in Ghana (Dadzie & Dzokoto, 2013). Given these challenges, it is essential to investigate the major environmental impacts of construction activities in Ghana and propose measures to mitigate them.

Tolga and Cenk, (2016) How The Residents Are Affected from Construction Operations Conducted in Residential Areas. World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, WMCAUS 2016. Therefore, there is a pressing need to comprehensively assess the impact of construction industries on residents in the Katsina metropolis of Katsina state to inform decision-making and improve the overall living conditions of the affected communities. with a focus on understanding the various challenges and opportunities associated with such developments.

### 1.6 Objectives of the Study

The aim of this research is to assess the impact of construction industries on residents living in residential areas, with a focus on understanding the various challenges and opportunities associated with such developments.

Specific Objectives:

- To examine the extent of noise pollution generated by construction activities and its impact on residents' well-being in residential areas.
- To assess the levels of air pollution resulting from construction operations and its effects on the health of residents.
- To investigate the traffic congestion caused by construction activities and its implications for residents' daily commuting and safety.
- To identify safety hazards from construction sites and their impact on residents.

## 2. RESEARCH METHOD

### 2.1 Study Area

The research area focuses on key residential neighborhoods and districts within Katsina Metropolis that are most affected by construction activities. The study specifically target residential areas where ongoing or recently completed construction projects (such as housing developments, road works or public infrastructure projects) are located.

Some potential research areas within Katsina Metropolis include: Areas where construction of affordable housing projects or public utilities is prevalent, such as Sabon Layi and Rafindadi.

Residents in these neighborhoods might face environmental and social impacts due to nearby construction activities. More also Areas that have a blend of commercial and residential activities, such as Kofar Kaura and Kofar Marusa, where ongoing construction of commercial infrastructure could significantly impact the quality of life of nearby residents. Then Older residential areas like Kofar Sauri, Unguwar Alkali, and Shinkafi, where construction of public amenities or redevelopment projects could affect the local environment and residents' everyday routines.

### 2.2 Data collection

The questionnaire was Distribute physically to residents in different neighborhoods of the city to

Ensure that respondents vary based on factors such as proximity to construction sites, age, length of residency, and type of residence. Aim for a diverse sample of residents in various residential areas of Katsina metropolis near construction sites.

### 2.3 Statistical Analysis

Descriptive Statistics was used to Summarize the responses to demographic questions and Likert-scale items (frequencies, means, etc.) to identify general trends in how residents perceive noise, air pollution, traffic and safety hazards. Neighborhoods was segment into high, medium and low construction activity areas and compare the means of well-being scores. The research use Regression Analysis to Examine how independent variables like noise pollution, air pollution and traffic congestion predict resident satisfaction and health. This will help identify which factors most significantly impact the residents.

This approach provide comprehensive perceptions into the impact of construction activities on residents in residential areas.

## 3. RESULT AND DISCUSSION

this chapter present's the figures as well as tabular results and discussion on the Assessing the impact of construction industries on residents in residential areas of Katsina metropolis of Katsina State of Nigeria. Using the data obtained from the questionnaire and interview administered.



**Table 1:** Demographic profile of the respondents

Age:	Frequency	Percentage
Below 20	50	16.6%
21-30	50	16.6%
31-40	100	33.3%
41-50	50	16.6%
51 and above	50	16.6%
<b>Total</b>	300	100%
<b>Gender</b>		
Male	250	83.3%
Female	50	16.5%
<b>Total</b>	300	100%
<b>Length of Residency:</b>		
Less than 1 year	10	3.3%
1-3 years	20	6.6%
4-6 years	30	10.0%
7-10 years	100	33.3%
10 years	140	46.6%
<b>Total</b>	300	100%
<b>Type of Residence</b>		
Apartment	100	33.3%
Detached house	50	16.6%
Semi- detached house	50	33.3%
Semi-detached house	50	16.6%
Townhouse	100	33.3%
<b>Total</b>	300	100%

In analyzing the demographic profile of residents impacted by nearby construction activities, several key factors were examined: age distribution, gender, length of residency, and type of residence. These demographic insights provide a foundation for understanding how different population segments perceive the effects of construction activities on their well-being. The age distribution of participants revealed a fairly even representation across the spectrum, with a notable concentration in the 31–40 age group, which constituted 33.3% of the sample. Each other age group represented 16.6%, including younger residents below 20 and older residents above 50. This balanced age distribution suggests a range of perspectives that can reveal diverse concerns and attitudes toward construction activities. The concentration in the 31–40 age range likely reflects individuals in the workforce who may be especially impacted by disruptions in routine caused by construction. Such a profile allows us to analyze potential differences in sensitivity to noise, air quality, and safety hazards among younger, middle-aged, and older residents.

Gender demographics indicate a significant skew, with males making up 83.3% of respondents and females comprising only 16.6%. This gender disparity may be reflective of broader social dynamics, such as male-dominated headship in households within the study area, or cultural patterns influencing household participation in surveys. The implications of this gender imbalance are essential for interpreting findings, as prior research has highlighted that men and women often have different thresholds for environmental nuisances and safety concerns. The dominance of male perspectives may skew results toward a lower sensitivity to noise and safety risks, as research has sometimes shown men to be more tolerant of such conditions. However, the responses still provide substantial insights into how the male demographic perceives construction impacts and any potential challenges unique to this group.

Examining the length of residency shows that the largest portion of respondents, 46.6%, have resided in their current location for more than ten years, followed by 33.3% who have lived there for 7–10 years. This data points to a high level of settlement stability among the respondents. Long-term residents are likely to have experienced a range of environmental conditions over time, making them particularly attuned to changes brought by construction projects. They may have a deeper perspective on how current construction activities compare to past conditions, providing valuable

context on changes in air quality, noise, and other issues. In contrast, those with shorter residency durations, who comprise only 3.3% of respondents, may lack this historical perspective but could offer fresh insights into the immediate impacts they perceive upon moving into the area.

The types of residence reported further shed light on the diversity of housing within the community and potential variations in exposure to construction impacts. Apartments and townhouses collectively represent 66.6% of the sample, with both categories equally comprising 33.3%. Detached and semi-detached houses, at 16.6% each, form the remaining 33.2%. The higher proportion of residents in apartments and townhouses suggests a more urbanized living arrangement, likely placing many residents in closer proximity to construction activities, thus potentially heightening their exposure to noise, dust, and traffic disruptions. Residents in detached houses, in contrast, may be somewhat more insulated from construction impacts due to increased spacing typical of these housing types. These residential patterns enable a nuanced analysis of how housing configurations influence sensitivity to environmental disturbances.

Overall, this demographic breakdown highlights a sample characterized by long-term male residents, predominantly middle-aged, with a strong representation from urbanized housing types. The data's diversity across age and residency length allows for comprehensive analyses on how the frequency and type of construction disturbances affect different demographic segments. The findings suggest that perceptions of construction impacts may vary significantly across these demographic lines, with potential differences in noise tolerance, safety concerns, and environmental sensitivity among distinct age groups and housing types. Consequently, these demographics provide valuable insights into how construction activities influence the well-being of residents and allow for targeted recommendations that can address the needs and concerns of the most affected groups within this residential population.

**Table 2:** Noise Pollution indicate a significant concern among residents

S/N	ITEM	SA	A	U	D	SD	Mean
1	I experience noise disturbances from nearby construction activities.	151	72	0	19	52	4.01
2	The noise from construction significantly affects my daily routines.	148	60	21	19	52	3.78
3	The noise pollution from construction activities has impacted my ability to concentrate at home	151	70	4	19	50	4.00
4	Noise from construction sites has reduced my overall well-being.	148	60	21	19	50	3.78

The data on noise pollution reveals significant concerns among residents regarding disturbances from construction activities. Most residents expressed high levels of agreement with statements regarding noise disturbances, with a substantial portion selecting "Strongly Agree" (SA) or "Agree" (A) across all items. For instance, in response to experiencing noise disturbances from construction, 151 respondents strongly agreed, while 72 agreed, resulting in a high mean of 4.01.

This pattern indicates that noise is not only present but highly intrusive for many residents. Similarly, when asked whether noise from construction activities impacted their ability to concentrate at home, the results were similar, with a mean of 4.00, suggesting that the issue is prevalent and disruptive to everyday functions. The high agreement rates reflect a community that perceives noise from construction as a frequent and substantial nuisance, particularly when it interrupts concentration and daily routines, pointing to a collective reduction in residents' quality of life due to this environmental disturbance.

Furthermore, the impact of noise pollution on well-being is evident from responses to the statement, "Noise from construction sites has reduced my overall well-being," which yielded a mean of 3.78. This result suggests that residents recognize noise not just as a temporary inconvenience but as a factor with tangible effects on their mental and physical health.

The moderate agreement in responses to the impact on daily routines (mean of 3.78) further emphasizes that while some residents may be more tolerant of noise, a considerable number feel that it disrupts their standard of living. The consistently high mean scores across these items indicate a pervasive sentiment that noise pollution from construction is diminishing overall resident satisfaction, especially among those most affected by it. This data highlights an urgent need for mitigation strategies to address noise levels in construction-heavy residential areas, as prolonged exposure could exacerbate stress and reduce well-being across the community.

**Table 3:** Air Pollution indicate a significant concern among residents

S/N	ITEM	SA	A	U	D	SD	Mean
1	I believe construction activities have worsened the air quality in my neighborhood.	70	130	50	20	30	3.70
2	I have experienced health issues (e.g., respiratory problems) due to air pollution caused by construction.	15	30	85	5	165	2.10
3	The dust and fumes from construction sites are a frequent concern in this area.	100	130	30	10	30	4.03
4	Air pollution from construction activities has made the environment less livable.	100	130	30	10	30	4.03

The findings on air pollution indicate a significant concern among residents regarding the impact of construction activities on air quality. Many respondents agreed or strongly agreed that construction has worsened air quality, with a mean score of 3.70. This suggests that air pollution is perceived as a pervasive issue, with over half of respondents expressing agreement. The data further shows a notable level of concern with dust and fumes, as responses to this item yielded a high mean score of 4.03. This indicates that the dust and fumes produced by nearby construction are seen as persistent irritants, likely contributing to a degraded environment and decreased quality of life for residents.

The perception of air pollution's impact on livability is equally strong, with a mean of 4.03 for the statement that construction activities have made the environment less livable. This suggests that residents feel the effects of air pollution go beyond mere inconvenience, affecting their overall well-being and satisfaction with their living environment. However, while many agree on the presence of air pollution, fewer report specific health issues, such as respiratory problems, directly attributed to construction, with a lower mean score of 2.10 on this item. This indicates that while the general awareness and concern for air pollution are high, fewer residents have experienced direct health symptoms, possibly due to individual health variability or differing exposure levels. Collectively, these results emphasize the need for air quality management in construction areas to alleviate the residents' environmental concerns and improve their living conditions.

**Table 4:** Traffic Congestion illustrates a strong consensus among residents

S/N	ITEM	SA	A	U	D	SD	Mean
1	Construction activities have significantly increased traffic congestion in my neighborhood.	167	47	29	25	32	4.01
2	I find it difficult to commute because of the traffic caused by construction projects.	138	69	50	40	3	3.98
3	Construction vehicles contribute to safety concerns on local roads.	57	87	70	50	26	3.37
4	Delays due to traffic congestion from construction have impacted my daily schedule.	160	47	39	22	32	3.98

The data on traffic congestion illustrates a strong consensus among residents that construction activities have significantly worsened traffic conditions in their neighborhoods. The high level of agreement with the statement that construction has increased traffic congestion is reflected in a mean score of 4.01, with 167 respondents selecting "Strongly Agree." This pattern indicates that construction activities are a major contributor to congestion, affecting residents' ease of movement. Additionally, the statement "I find it difficult to commute because of the traffic caused by construction projects" also received a high mean score of 3.98, with many residents reporting agreement. This reinforces the view that commuting has become more challenging due to construction-related traffic, and many respondents feel this negatively impacts their daily experience.

Safety concerns related to construction vehicles also emerged, albeit with a lower intensity. The mean score of 3.37 for the statement "Construction vehicles contribute to safety concerns on local roads" shows moderate agreement. This suggests that, while traffic congestion and delays are of greater concern, safety remains an issue for a significant number of residents. Furthermore, the impact of traffic delays on daily schedules was evident, with a mean score of 3.98, indicating that congestion affects not only commuting but also the residents' broader schedules and routines. Collectively, these findings point to the need for careful traffic management in construction zones to reduce congestion, enhance safety, and minimize disruption to residents' daily lives.

**Table 5:** Safety Hazards on construction sites indicate significant levels of concern among residents

S/N	ITEM	SA	A	U	D	SD	Mean
1	I believe construction sites pose significant safety hazards to residents in this area.	99	80	37	52	32	3.43
2	The presence of heavy machinery near residential areas is concerning.	50	50	100	50	50	3.00
3	Safety measures around construction sites are often inadequate.	49	73	49	49	180	2.43
4	I worry about accidents occurring near construction sites that could affect residents.	79	179	37	5	0	4.11

The findings on safety hazards related to construction sites indicate mixed yet significant levels of concern among residents. The highest level of agreement was recorded for the item "I worry about accidents occurring near construction sites that could affect residents," with a mean score of 4.11. This high score, with many respondents selecting "Strongly Agree" or "Agree," reflects a widespread anxiety regarding potential accidents around construction zones, underscoring the perceived risks construction sites pose to nearby communities. The perception that construction sites pose general safety hazards to residents shows moderate agreement, with a mean of 3.43, indicating that while many respondents are aware of potential dangers, the level of concern is somewhat tempered. Notably, the concern regarding the presence of heavy machinery near residential areas yielded a mean of 3.00, suggesting that the presence of such equipment is acknowledged but may not be perceived as immediately threatening by all residents. However, there is a low mean score of 2.43 on the statement "Safety measures around construction sites are often inadequate," indicating that while residents are concerned about potential accidents, they may feel that at least some safety measures are in place. These results point to a general awareness of construction-related risks, with room for improvement in safety protocols to further reduce anxiety and enhance residents' sense of security near construction sites.

### 3.1 Regression Analysis

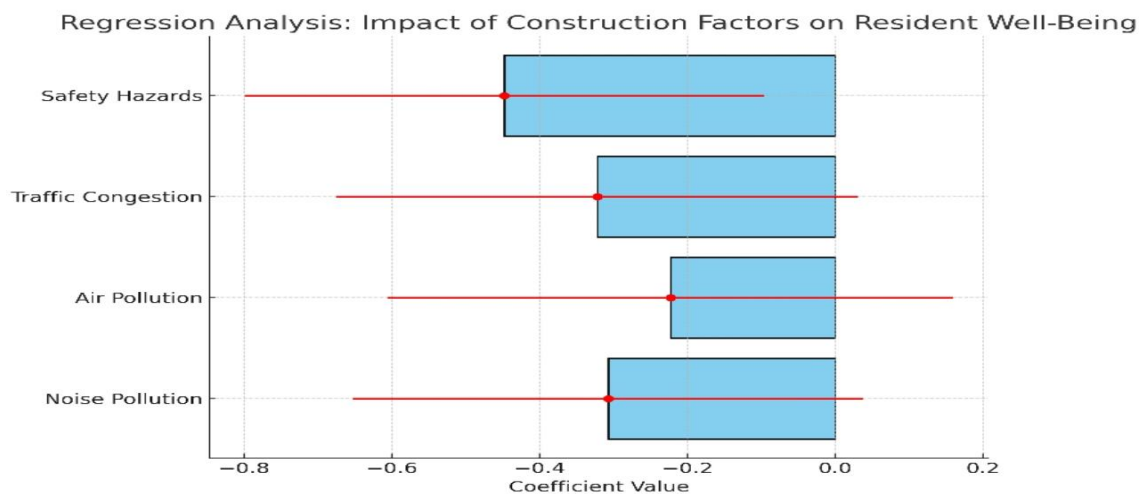
**Table 6:** Regression analysis table represent the results of a multiple linear regression model

Variable	Coefficient	Std. Error	t-Value	P> t	95% Confidence Interval
Constant	7.7078	0.667	11.558	0.000	[6.286, 9.129]
Noise Pollution	-0.3074	0.161	-1.904	0.076	[-0.652, 0.037]
Air Pollution	-0.2230	0.179	-1.246	0.232	[-0.605, 0.159]
Traffic Congestion	-0.3221	0.166	-1.944	0.071	[-0.675, 0.031]
Safety Hazards	-0.4479	0.165	-2.722	0.016	[-0.799, -0.097]

The regression analysis table above presents the results of a multiple linear regression model examining the impact of various environmental factors noise pollution, air pollution, traffic congestion, and safety hazards on residents' perceptions of well-being in areas affected by construction activities. This type of regression analysis aims to quantify the relationship between these independent variables and the dependent variable, which could be residents' overall satisfaction or quality of life related to the construction environment. The model includes key coefficients for each predictor, as well as their respective standard errors, t-values, p-values, and 95% confidence intervals.

In terms of interpretation, the constant term of 7.7078 indicates the baseline level of well-being when all independent variables are held constant. The negative coefficients for noise pollution (-0.3074), air pollution (-0.2230), and traffic congestion (-0.3221) suggest that as these factors increase, residents' perceived well-being tends to decrease. The t-values and p-values indicate the statistical significance of these predictors. Specifically, noise pollution ( $p = 0.076$ ), traffic congestion ( $p = 0.071$ ), and air pollution ( $p = 0.232$ ) are not statistically significant at the typical 0.05 threshold. However, safety hazards ( $p = 0.016$ ) is statistically significant, with a negative coefficient of -0.4479, suggesting that greater safety concerns related to construction activities have a significant and negative impact on residents' well-being. The confidence intervals provide additional insight into the range of possible values for each coefficient, showing that safety hazards have the most substantial and reliable effect, while the other environmental factors exhibit more variability in their impact. Overall, the results highlight that safety hazards have the most direct and statistically significant influence on residents' perceptions, while noise, air pollution, and traffic congestion, although impactful, are less significant in this specific model.





**Figure 1.** Chart representing Regression analysis on impact of construction factors on relevant well-being

The figure above represents the regression analysis results for the impact of construction factors (Noise Pollution, Air Pollution, Traffic Congestion, and Safety Hazards) on residents' well-being. The horizontal bars indicate the coefficients for each variable, while the red error bars show the 95% confidence intervals for these coefficients. The analysis suggests that Safety Hazards has the most significant negative impact, as indicated by its coefficient of -0.4479, with a 95% confidence interval ranging from -0.799 to -0.097. Other factors like Noise Pollution, Air Pollution, and Traffic Congestion have less significant coefficients, with their confidence intervals crossing zero, suggesting that their effects may not be as strong.

### 3.2 Discussion of findings

The demographic analysis of residents impacted by nearby construction activities highlights key characteristics, including age, gender, length of residency, and type of residence. The age distribution reveals a fairly balanced spread across various groups, with a notable concentration of 33.3% in the 31–40 age range, followed by equal representation from other age groups. This age concentration suggests that individuals in the workforce are likely the most affected by disruptions caused by construction activities, such as noise, air pollution, and safety hazards. Gender distribution, however, presents a significant disparity, with 83.3% male and 16.6% female respondents, reflecting broader societal and household dynamics that may influence responses, especially regarding environmental nuisances and safety concerns. This gender imbalance should be considered when analyzing how different genders perceive the effects of construction. The length of residency further reveals that long-term residents (46.6% having lived in their current location for over ten years) are more likely to have a deeper perspective on construction impacts, comparing current disturbances to past conditions, while newer residents may provide insights into the immediate effects of construction activities. Additionally, the diversity in housing types (e.g., apartments and townhouses making up 66.6% of the sample) suggests varying levels of exposure to construction noise and dust, with residents in more densely packed housing potentially facing greater environmental disturbances.

The analysis of noise pollution reveals significant disruption for residents living near construction sites. High mean scores across all noise-related items (such as the impact on concentration and daily routines) point to widespread disturbance, with a mean of 4.01 for the statement "I experience noise disturbances from nearby construction activities." This suggests that noise is a pervasive issue, deeply affecting residents' ability to function daily. The moderate agreement (mean of 3.78) on the reduction of overall well-being further indicates that the effects of construction noise are not merely temporary inconveniences but are having a tangible impact on the residents' mental and physical health. The results underscore the need for noise mitigation strategies in construction-heavy areas to prevent further detriment to residents' quality of life. Similarly, air pollution due to construction activities was highlighted as a major concern, with a mean score of 4.03 for dust and fumes being a frequent issue. Although fewer residents reported experiencing direct health issues, the general perception of worsened air quality (mean of 3.70) and the negative impact on livability (mean of 4.03) indicate that the environmental degradation caused by construction is a significant and ongoing concern. The data suggests that air quality management is necessary to address residents' environmental and health concerns effectively.

Traffic congestion and safety hazards emerged as other key issues influenced by construction activities. A strong consensus among residents (mean score of 4.01) identified construction as a major contributor to increased traffic congestion, significantly affecting commuting and daily routines. Additionally, 3.98 mean scores for statements

regarding the difficulty of commuting and the impact on daily schedules further underline the substantial disruption caused by traffic delays. However, the concern over safety hazards, especially related to construction vehicles and heavy machinery, also garnered notable attention, though with slightly lower mean scores. The most concerning safety issue was the potential for accidents, which generated the highest agreement (mean score of 4.11), emphasizing widespread anxiety about the risks posed by construction sites to residents. While there was moderate agreement that safety measures around construction sites are often inadequate (mean of 2.43), this perception points to a significant gap in the effectiveness of safety protocols in construction zones. The findings from these areas highlight the importance of developing comprehensive traffic management strategies and implementing rigorous safety measures to reduce both congestion and the risk of accidents in residential areas affected by construction. Together, the demographic insights and impact assessments suggest that construction activities in residential neighborhoods pose serious challenges to the well-being, safety, and quality of life of residents, requiring targeted interventions to mitigate these issues.

#### 4. CONCLUSION

The research concludes that construction activities within Katsina Metropolis' residential areas significantly impact the daily lives and well-being of local residents. Noise and air pollution are primary concerns, with respondents frequently reporting disruptions to their routines, heightened stress levels, and decreased mental and physical health. Traffic congestion, resulting from construction activities, restricts residents' movement and schedules, while safety hazards linked to construction vehicles and machinery increase anxiety about potential accidents. Although some construction firms have implemented limited mitigation strategies, the measures are generally insufficient to address the community's primary concerns. This study emphasizes the need for more comprehensive and sustainable construction practices that prioritize residents' well-being. By engaging local communities from the early stages of planning and implementing robust environmental and safety controls, construction firms and urban planners can minimize adverse effects, fostering a more harmonious coexistence between development initiatives and the needs of urban populations.

#### 5. RECOMMENDATION

Base on the findings within the metropolitan of Katsina state following recommendation are made to Katsina state government and the companies owners to adopt in other to be free, fair to the residents

- Construction companies should engage with local residents from the planning stage of projects. This will allow for better management of expectations and the early identification of potential adverse effects on communities.
- Construction firms should adopt stricter environmental control strategies to reduce noise, dust, and pollution. Installing noise barriers and dust control systems and adhering to strict work-hour limits could minimize disruptions.
- Implement better traffic management plans, especially in areas where road closures or detours are necessary. Providing residents with clear information on alternative routes and ensuring that traffic flow is efficiently managed during construction periods is essential.
- Local governments and health agencies should collaborate to monitor the health impacts of construction on nearby residents. This would allow early detection of health issues, particularly respiratory and stress-related conditions, and enable prompt interventions.
- Urban planners (KUPDA) and government officials should prioritize sustainable construction practices that minimize the long-term negative effects on both the natural environment and human health. Incorporating green building technologies and improving waste management strategies are essential for creating more livable urban environments.
- KUPDA Should conduct regular assessments of construction impacts on residential areas to ensure that negative effects are being addressed in real-time and that mitigation measures are continuously improved.

#### Research Contribution

This study makes several important contributions to urban development and construction management, particularly in the context of Katsina Metropolis and similar urban centers in developing regions. It also provides how construction activities in residential areas affect the lives of people in a Nigerian context, contributing to a relatively understudied area of urban development in Katsina State. And The findings can guide local governments in formulating policies that enforce sustainable construction practices, ensuring that future development in Katsina Metropolis is resident-friendly and ecologically responsible.

#### 6. REFERENCES

- [1] Aboginije, A., Aigbavboa, C., Thwala, W., (2020). Determining the impact of construction and
- [2] demolition waste reduction practices on green building projects in Gauteng province, South Africa. In: Proceedings of the International Conference on Industrial Engineering and Operations Management. UAE, Dubai.

- [3] Adewuyi, T.O., Odesola, I.A., (2016). Material waste minimization strategies among construction
- [4] firms in south-south Nnigeria. *International Journal of Sustainable Construction Engineering & Technology* 7 (1), 11–29.
- [5] Ahmed, R. (2012). “Construction and the environment” Control Directorate, Public Commission for the Protection of Marine Resources, Environment and Wildlife, Kingdom of Bahrain,
- [6] Ajayi, S.O., et al., (2017). Optimising material procurement for construction waste minimization: an exploration of success factors. *Sustainable Materials and Technologies* 11, 38–46.
- [7] Akadiri, P.O., Chinyio, E.A., Olomolaiye, P.O., (2012). Design of a sustainable building: a
- [8] conceptual framework for implementing sustainability in the building sector. *Buildings* 2 (2), 126–152.
- [9] Al-Hajj, A., Hamani, K., (2011). Material waste in the UAE construction industry: main causes and minimization practices. *Architect. Eng. Des. Manag.* 7 (4), 221–235.
- [10] Amit, B. D. and Ipshita, S. (2014). “Environmental Impact Assessment (EIA) and Construction” *International Research Journal of Environment Sciences* Vol. 3(1), 58-61.
- [11] Anderson, J., Thornback, J., (2012). *A Guide to Understanding the Embodied Impacts of Construction Products*. Construction Products Association, London.
- [12] Aremu, A. S., Aremu, A.O. and Olukanni D. O. (2015). Assessment of Noise Pollution from
- [13] Sawmill Activities in Ilorin, Nigeria." *Nigerian Journal of Engineering Technology* Vol 34(1), 72-79.
- [14] Aslam, M.S., Huang, B., Cui, L., (2020). Review of construction and demolition waste management in China and USA. *J. Environ. Manag.* 264 (110445).
- [15] Azqueta, D. (1992). ‘Social project appraisal and environmental impact assessment: a necessary but complicated theoretical bridge’, in *Development Policy Review*, Vol. 10, pp. 255–270.
- [16] Baniyas, G., et al. (2011). A web-based decision support system for the optimal management of construction and demolition waste. *Waste Manag.* 31, 2497–2502.
- [17] Bentivegna, V., Curwell, S., Deakin, M., Lombardi, P., Mitchell, G. & Nijkamp, P. (2002). ‘A
- [18] vision and methodology for integrated sustainable urban development: BEQUEST’, in *Building Research and Information*, Vol. 30, No. 2, pp. 83–94.
- [19] Burningham, K. (2000). Using the Language of NIMBY: A topic for research, not an activity for researchers, *Local Environment*. 555-67.
- [20] Cardoso J.M. (2005). Construction site environmental impact in civil engineering education *European Journal of Engineering Education*, 30(1), pp. 51-58.
- [21] Castellano, J., Ribera, A., Ciurana, J. (2016). Integrated system approach to evaluate social,
- [22] environmental and economics impacts of buildings for users of housings. *Energy Build.* 123, 106–118.
- [23] Chen Z., Li H. & Wong C.T.C. (2000). Environmental management of urban construction project in China. *Journal of Construction Engineering and Management*, 126(4), pp. 320-324.
- [24] Chen Z., Li H. & Wong C.T.C. (2005). Environmental Planning: Analytic network process model
- [25] for environmentally conscious construction planning. *Journal of Construction Engineering and Management*, 131(1), pp. 92-101.
- [26] CIB (1999) *Managing Construction Industry Development in Developing Countries: Report on*
- [27] *the First Meeting of the CIB Task Group 29*. Arusha, Tanzania, 21-23 September. Rotterdam
- [28] Cole R.J. (2000). Building environmental assessment methods: Assessing construction practices. *Construction Management and Economics*, 18(8), pp. 949-957.
- [29] Curwell, S. & Cooper, I. (1998). ‘The implications of urban sustainability’ in *Building Research and Information*, Vol. 26, No. 1, pp. 17–28.
- [30] Da Paz, D.H.F., et al., (2018). Assessment of environmental impact risks arising from the illegal dumping of construction waste in Brazil. *Environ. Dev. Sustain.* 22, 2289–2304.
- [31] Deng, X., Hu, Y., Deng Y. and Mahadev, S. (2014). An Environmental impact assessment based on the numbers” *Expert Systems with Applications*, pp. 635–643,
- [32] Edwards, B., (2014). *Rough Guide to Sustainability: A Design Primer*. RIBA Publishing, London.
- [33] ELARD, GAA, 2009. Environmental and Social Impact Assessment of Construction and
- [34] Operation of Syria Cement Plant and Captive Power Plant, and Associated Quarrying Activities. Syrian cement company, Syria (scc).
- [35] Enshassi, A., Al-Hallaq, K., Mohamed, S., 2006. Causes of contractors’ business failure in developing countries: the case of Palestine. *J. Constr. Dev. Ctries. (JCDC)* 11 (2), 1–14
- [36] Eze, E.C., Seghosime, R., Eyong, O.P., Loya, O.S., 2016. Assessment of materials waste in the

- [37] construction industry: a view of construction operatives, tradesmen and artisans in Nigeria. *Int. J. Eng. Sci.* 6 (4), 32–47.
- [38] Ghaleb, J.S., et al., 2021. Understanding the causes of material wastage in the construction industry.
- [39] Gilchrist A. and Allouche, E.N. (2005) Quantification of social costs associated with construction
- [40] projects: state-of-the-art review, *Tunnelling and Underground Space Technology*. 2089-104.
- [41] Gottsche, J., Kelly, M., 2018. Assessing the impact of construction waste reduction on selected projects in Ireland. *Waste Res. Manag.* 171 (3), 71–81.
- [42] Hakan, A., Nilay, C., Burcu, S., 2012. Construction and Demolition Waste Management in Turkey. *Waste Management*, pp. 314–332.
- [43] Husnain, A., Muhammad, Q., Muhammad, J.T., Hamza, F.G., 2017. Quantification of material
- [44] wastage in construction industry of Pakistan: an analytical relationship between building types and waste generation. *J. Constr. Dev. Ctries. (JCDC)* 22 (2), 19–34.
- [45] Ignacio, Z.B., Antonio, V.C., Alfonso, A.U., 2011. Life cycle assessment of building materials:
- [46] comparative analysis of energy and environmental impacts and evaluation of the eco-efficiency improvement potential. *Build. Environ.* 46 (5), 1133–1140.
- [47] Jawad, Al-R., Omar, A., 2016. Understanding the key factors of construction waste in Jordan. *Jordan J. Civil Eng.* 10 (2), 244–253.
- [48] Jekale, W., 2004. Performance for Public Construction Projects in Developing Countries: Federal
- [49] Road and Educational Building Projects in Ethiopia. Norwegian University of Science and Technology.
- [50] Kabirifar, K., Mojtahedi, M., Wang, C.C., 2021. A systematic review of construction and
- [51] demolition waste management in Australia: current practices and challenges. *Recycling* 6 (2), 34.
- [52] Laborel-Preneron, A., et al., 2016. Plant aggregates and fibers in earth construction materials: a review. *Construct. Build. Mater.* 111, 719–734.
- [53] Lopes, J.P., Oliveira, R.A., Amreu, M.I., 2011. The Construction Industry and the Challenges of
- [54] the Millennium Development Goals. *Management and Innovation for a Sustainable Built Environment*. Amsterdam, The Netherlands. <http://resolver.tudelft.nl/uuid:8c0f430b-045a-428a-a188-84575441c605>.
- [55] Lu, W., Yuan, H.P., (2011). A framework of understanding waste management studies in construction. *Waste Manag.* 31 (6), 1252–1260.
- [56] Luangcharoenrat, C., Intrachooto, S., Peansupap, V., Sutthinarakorn, W., 2019. Factors
- [57] influencing construction waste generation in building construction: Thailand's perspective. *Sustainability* 11 (13), 3638.
- [58] March M.C. (1992), Construction and environment: a management matrix. *Chartered Builder*, 4, pp.11-12.
- [59] Merino, M.d.R., Gracia, P.I., Azevedo, I.S.W., 2010. Sustainable construction: construction and demolition waste reconsidered. *Waste Manag. Res.* 28 (2), 118–129.
- [60] Muhammad, F.H., et al., 2020. The on-site waste minimization practices for construction waste.
- [61] IOP Conference Series: materials Science and Engineering. *IOP Conf. Ser. Mater. Sci. Eng.* 713, 012038.
- [62] Mydin, M.O., Khor, J.C., Sani, N.M., 2014. Approaches to construction waste management in
- [63] Malaysia. *Advanced green material and Technology symposium (AGMTS 2014)*. MATEC Web Conf. 17, 1014
- [64] Narcis, N., Ray, I., Hosein, G., 2019. Construction and demolition waste management actions and potential benefits: a perspective from Trinidad and Tobago. *Buildings* 9 (6), 150.
- [65] Nguimalet, C.R., 2007. Population and Spatial Growth: Diagnosis and Implications for Urban Management in Bangui (Central African Republic), pp. 1–16.
- [66] Ofori, G., 2015. Nature of the construction industry, its needs and its development: a review offour decades of research. *J. Constr. Dev. Ctries. (JCDC)* 20 (2), 115–135.
- [67] Oladipo, F.O., Oni, O.J., 2012. A review of selected macroeconomic factors impacting building
- [68] material prices in developing countries- a case of Nigeria. *Ethiop. J. Environ. Stud. Manag. EJESM* 5 (2), 131–137.
- [69] Olander, S. and Landin, A. (2008). A comparative study of factors affecting the external stakeholder management process, *Construction Management and Economics*. 26 553-561.
- [70] Olanrewaju, S.D., Ogunmakinde, O.E., 2020. Waste minimisation strategies at the design phase: architects' response. *Waste Manag.* 118, 323–330.
- [71] Olusanjo, O.F., Panos, G., Ezekiel, C., 2014. Quantitative analysis of the sources of construction waste. *J. Constr. Eng.* 2014 (651060), 9.
- [72] Patel, A. (2014). Criteria based decision support system for Environmental clearance in Amreli



- [73] and Junagarh districts using Geo-informatics” International Journal of Engineering research and technology, 2014, 1434-1438.
- [74] Polat, G., Damci, A., Turkoglu, H., Gurgun, A.P., 2017. Identification of root causes of
- [75] construction and demolition (C&D) waste: the case of Turkey. *Procedia Eng.* 196, 948–955.
- [76] Rodríguez, G., et al. (2020). Construction and demolition waste applications and maximum daily output in Spanish recycling plants. *Waste Manag. Res.* 38 (4), 423–432.
- [77] Selvakumar, S. and Jaykumar, R. K. C. (2016). “Environmental impact assessment for building
- [78] projects” *Proceeding of International Conference on Energy, Environment and Engineering*, At CIT, Coimbatore.
- [79] Shen L.Y. & Tam V.W.Y. (2002). Implementation of environmental management in the Hong
- [80] Kong construction industry. *International Journal of Project Management*, 20(7), pp. 535-543.
- [81] Shen, L.y. et al., (2010). Project feasibility study: the key to successful implementation of
- [82] sustainable and socially responsible construction management practice, *Journal of Cleaner Production*. 18254-259.
- [83] Solís-Guzman, J., Marrero, M., Montes-Delgado, M., Ramírez-de-Arellano, A., (2009). A Spanish
- [84] model for quantification and management of construction waste. *Waste Manag.* 29 (9), 2542–2548.
- [85] Tafesse, S., 2020. A review on the critical factors causing delay of delivery time in construction projects. *Int. J. Eng. Technol. IJET* 6 (4), 69–81.
- [86] Tafesse, S., Aduugna, T. (2021). Critical factors causing material wastes in building construction projects. *J. Eng. Sci.* 17 (2), 1–16.
- [87] Tam, W.Y., (2008). On the effectiveness in implementing a waste-management-plan method in construction. *Waste Manag.* 28 (6), 1072–1080.
- [88] Teo, M.M. and Loosemore, M. (2011). Communityöbased protest against construction projects:
- [89] a case study of movement continuity, *Construction Management and Economics*. 29131-144.
- [90] Teo, M.M.M. (2009). An investigation of community. Based protest movement continuity against construction projects. *Built Environment*. PhD. University of New South Wales, Sydney,.
- [91] Tolga and Cenk (2016) investigate How the Residents Are Affected from Construction Operations
- [92] Conducted in Residential Areas The construction projects have adverse impacts on the residents who live at a neighborhood of a construction project
- [93] United Nations Environment Programme Buildings and Climate Change “Summary for DecisionMakers” UNEP DTIE, Sustainable Consumption and Production Branch, 2009.
- [94] Venugopal, R.B., Sundeeep, K.N., Venkatesh, K., 2020. A study on factors involved in
- [95] implementation of supply chain management in construction industry. *Mater. Today Proc.* 33 (1), 446–449.
- [96] Vivek K. T., Anjali V., Akash K. and Manjul G. (2016). A review on Environmental Impact
- [97] Assessment of Construction Projects” *Journal of Environmental Science, Toxicology and Food Technology* Vol 10(1), , 21-25.
- [98] Wang, Y. M., Yang, J. B. and Xu, D. L. (2006) Environmental impact assessment using the
- [99] evidential reasoning approach, *European Journal of Operational Research*. 174. 1885-1913.
- [100] Wong, E.O., Yip, R.C., (2004). Promoting sustainable construction waste management in Hong Kong. *Construct. Manag. Econ.* 22 (6), 563–566.
- [101] Wu, Z., Yu, A.T., Shen, L., (2016). Investigating the determinants of contractor’s construction and demolition waste management behavior in Mainland China. *Waste Manag.* 60, 290–300.
- [102] Yeheyis, M., et al., (2013). An overview of construction and demolition waste management in
- [103] Canada: a lifecycle analysis approach to sustainability. *Clean Technol. Environ. Policy* 15, 81–91.
- [104] Yuan, H., Chini, A.R., Lu, Y., Shen, L., 2012. A dynamic model for assessing the effects of
- [105] management strategies on the reduction of construction and demolition waste. *Waste Manag.* 32, 521–531. S
- [106] Zobel T. & Burman J. O. (2004). Factors of importance in identification and assessment of
- [107] environmental aspects in an EMS context: Experiences in Swedish organizations. *Journal of Cleaner Production*, 12 (1), pp. 13-27.