INTERNATIONAL JOURNAL OF BUILT ENVIRONMENT & SUSTAINABILITY

eISSN 2289-8948

Vol 10, No 1 (2023)

https://ijbes.utm.my/

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UNIVERSITI TEKNOLOGI MALAYSIA

IJBES

International Journal of Built Environment and Sustainability

Mail Address:
International Journal of Built Environment and Sustainability
Faculty of Built Environment and Surveying
Universiti Teknologi Malaysia
81310, Johor Bahru, Malaysia
Telephone: +60-7-5537382
Email: ijbes@utm.my

Cover Design and Type-set by: Shamsulhadi/Hairunnisa/Azman

The IJBES is an international peer-reviewed Journal
Published in collaboration between Faculty of Built Environment and Surveying and Penerbit UTM

E-ISSN: 2289-8948
ISSN: 1511-1369

IJBES

Vol. 10, No. 1, 2023

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UTM UNIVERSITI TEKNOLOGI MALAYSIA

IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 1-16

Identifying Factors Influencing Organizational Leadership for Adequate Housing Delivery in Nigeria: A Delphi Survey Approach

David Ngwoke Mbazor
Department of Estate Management, School of Environmental Technology, Federal University of Technology Akure, Nigeria

Clinton Ohis Aigbavboa
Department of Construction Management & Quantity Surveying, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa

Wellington Didibhuku Thwala
Department of Civil Engineering, University of South Africa, Pretoria, South Africa

ABSTRACT

Nowadays, there exists a high incidence of competitions between organizations seeking control, relevance, and dominance in the market space due to globalization exacerbated by the continuous advancement in technologies, high customers' tastes, and expectations. This has significantly influenced organizational decisions leading to constant reevaluation of operational procedures, adopting and implementing changes that will influence positive business outcomes. The literature search revealed that past studies on organizational leadership focused mainly on elements of leadership styles, strategies, and ethics. Hence, studies have not identified the factors that influence organizational leadership for adequate housing delivery in Nigeria. The study identified the factors that influence organizational leadership in the delivery of housing in Nigeria using the Broaden and Build theory, and Kurt Lewin's leadership philosophical concepts as the fundamental basis underpinning the study. Delphi study approach was used to determine the areas of commonality before a consensus was reached. A structured questionnaire was administered to validate and removing outliers from the result. The Delphi study identified 20 distinct factors that influence organizational leadership for AHD in Nigeria. Factors such as organizational sustainability, motivation, etc., are the most significant factors influencing organizational leadership towards AHD. However, results from SEM analysis showed that only 12 variables are significant in measuring organizational leadership and management for AHD. The study concludes that the 12 identified factors are significant in AHD. Nevertheless, the application of these factors in housing delivery is still low in Nigeria. Hence, it is recommended that real estate developers and other operators in housing should use the result from this study as a template for developing adequate housing.

Article History

Received : *03 March 2022*
Received in revised form : *03 July 2022*
Accepted : *29 September 2022*
Published Online : *31 December 2022*

Keywords:

Delphi technique; Housing adequacy, housing provision, leadership, organizational management.

Corresponding Author Contact:
dnmbazor@futa.edu.ng

DOI: 10.11113/ijbes.v10.n1.947

1. Introduction

The real estate construction industry, housing sub-sector in particular is complex because it comprises people of diverse professions and ages, from different cultural and social-economic backgrounds, possessing varying degrees of perceptions, who understand things differently (Mbazor & Okoh, 2014). These obvious diversities present enormous challenges to organizational leaders, who are constantly saddled with the responsibilities of effective management and control of resources in such a manner as to meet the corporate objectives of the organization.

Several studies exist on different aspects of delivering housing adequacy. As a result, a variety of ideas and definitions on housing adequacy can be found in the literature. Maliene & Malys (2009) for instance sees housing adequacy as a way of delivering a healthy and attractive living environment within the society. The study considered housing adequacy based on a good, high-quality, economic, ecological, aesthetical design, comfortable and convenient to sufficiently suit the needs of an occupier. Unfortunately, not much attention has been paid in the literature to the issue of leadership and management practices that result in adequate housing. Without effective organizational leadership and management practices, adequate housing delivery will be a mirage. Consequently, Sze´kely & Knirschm (2005) pointed that "several organizations have embarked on different strategies to address the housing need and expectations of the investors and the general public.

The issue of organizational leadership creates important understandings on leadership and management functions in all segments of organizational operations, housing delivery inclusive. This study primarily focused on identifying the factors influencing leaderships among the chief executives (CEOs), sectional leaders, line managers, and supervisors in the organizations' practices such as the housing delivery industries. Organization of any size, nature, and nomenclature is a complex, dynamic and unique entity. The day-to-day actions and decisions taken in an organization are the core and basic reasons for leadership.

This research is poised to identify the influencing factors based on experiences, skills, and technical knowledge used by the selected experts, to improve leadership styles to achieve the quality objectives of their organizations. In highlighting the problem statement of the study, issues such as lack of societal responsibilities, poor leadership process, lack of friendly approach to leadership, and lack of commitment in taking initiatives are part of the obvious challenges among leaders in the housing industry (Mbazor & Okoh, 2015). These factors, to a great extent have influenced the overall performance of organizations including the housing organizations. Further, Ejimabo (2015) found that most organizational problems normally present themselves in non-associated symptoms. The study mentioned that the usual tendencies of employees of an organization including the chief executive officers (CEOs) are to tackle the symptoms of the identified problems, and left the real problem unattended. This approach has been noted to be one of the major shortcomings of organizational leaders. But Olsen & Eoyang (2001) posits that seeing challenges from different angles within an organization give a broader view and better understanding of such problem. Hence, it is pertinent that leaders of organizations should imbibe the culture of critically evaluating problems rather than running into quick actions and conclusions that would not produce lasting solutions to the problem.

Several studies have been undertaken on the subject of organizational leadership in different fields, but there is a gap in the literature on the influence of organizational leadership and management concerning AHD process in a developing country such as Nigeria.

The Delphi and survey techniques employed in this study primarily focused on identifying the major elements influencing leadership effectiveness among the exparts and other operators in housing organizations' day-to-day activities. The technique allowed the selected experts and others to freely air their individualistic perceived opinions on the leadership constructs presented to them by the researchers, and at the same time allowed the participants the freedom to make their independent opinions which were subjected to further evaluation by other participants to build a consensus on the opinions expressed. Through the adoption of a mix approach (Delphi and survey study approach), the researchers intention is to conduct comprehensive contextual analyses; with emphasis on identifying leadership attributes that create the structure for assisting housing organizations' leaders to effectively deploy their skills and experience in leading their organizations towards attaining housing adequacy goal.

In assessing adequate housing delivery programs, the perceptions of final beneficiaries and the general public on the final housing product are always of great concern to the constructors, policymakers, and indeed the entire stakeholders. The focus and concerns about the final housing product are usually expressed primarily based on the satisfaction derived in terms of the quality of the fabrics used and the entire housing environment. Humans by their nature have the intrinsic tendency to place value on their immediate environment, and based on what they perceive to be good or bad. This instinct evaluation in man is generally influenced by cultural value, level of adaptation, and past experiences, age, gender, social status, and political roles.

Therefore, for the developer to ensure adequate housing delivery that will satisfy the final beneficiaries, effective leadership, and management structure must be deployed by leaders to influence the subordinates for enhanced products outcomes. Unlike the developed countries, little research has been carried out in developing countries such as Nigeria on the factors that influence organizational leadership and management in the delivery of adequate housing.

Hence, this research aims to investigate the factors that influence organizational leadership for adequate housing delivery. It is anticipated that the study will contribute to the body of knowledge by adding to the existing literature on how leadership characteristics in the housing sector can positively influence teams' performance, and by so doing ensuring the realization of adequate housing delivery objectives that satisfies the end users.

Underlying Theory For The Study (Broaden-And-Build Theory And Kurt Lewin's Leadership Philosophical Concepts)

This research adopted the conceptual framework developed by Frederickson (2001). This framework however has an underpinning theory of Broaden–and-Build theory of leadership influence and Kurt Lewin's leadership philosophical concepts of leadership. The Broaden-and-Build theory according to Frederickson (2001) gave an explanation of how the concept of positivity in leadership connects to the improvement and well-being of an organization, and how it contributes to adaptability, growth, and effective work performance. The theory posits that "positive emotions broaden awareness as well as thinking and action repertoires". Also, Kurt Lewin's leadership philosophical concepts focused on "the classic experiments with authoritarian and democratic styles of leadership." The results of the experiments showed that the factors that determine individual or group behaviors in an organization are the styles of leadership and not the individual or group differences as generally believed. It was Lewin's leadership concepts that initiated the movement toward a democratic style of leadership in an organization.

Similarly, Vacharkulsemsuk & Frederickson (2013) pointed that "positive emotions contribute to building enduring cognitive, physical, social, and relational resources". This theory implies that positive affective conditions or states broaden abilities to be able to formulate novel and effective concepts, taking alternative actions to improve their competencies, enhance the connectivity of team members, and add to the organizational growth and product improvement (Sekerka & Frederickson, 2008; Vacharkulsemsuk & Frederickson, 2013). Furthermore, relating affective states or conditions, either positive or negative on certain work outcomes, past studies such as Tsai et.al (2009) revealed that leadership influences work performance directly and indirectly.

This suggests that when positive effects are put up by leaders say in the delivery of housing, it will have a ripple effect with the capacity to motivate the subordinates (such as the masons, carpenters, welders, etc.) to deliver efficiently, and on the other hand, negative effects will demotivate the subordinates resulting to poor work performance. The outcomes of the study contribute significantly to the literature on the roles positive conditions plays between leadership and actual performance of an organization.

2. Literature review

The term leadership has received very wide descriptions from diverse disciplines. Leadership as a concept is a term generally considered to be significant in the diverse operations of any given institution, organization, group, association, general society. Leadership studies have been an important topic that has attracted a wide range of discussions across disciplines ranging from science, sociology, psychology, natural and social sciences among other disciplines. The subject has produced myriads of conceptual and empirical researches and has generated several intellectual debates and discuses among experts. Many ideas have been given to the subject of leadership. For instance, Yukl (2010) informed that leadership is a term derived from the common lexis and integrated into the official lexis of a scientific field.
Several other researchers' perceptions of leadership are identified in the literature. For example, Northouse (2014) considered leadership as a tailored process where individuals influence groups or individuals to achieve a common set out goals. Drath & Palus (1994) asserts that leadership is an idea of 'making meaning out of someone else's joint actions, and in such a manner that the actions could be understood and followed. It is also defined as a process used in influencing others to consent to an idea in an understandable manner (Yukl, 2010)). Leadership according to Jacobs & Jaques (1990) is a process of giving direction to a collective effort to achieve a goal. It supports and promotes organizational sustainability (Epstein, et al. 2010).

Leadership according to Misztal (2013) is pre-condition through which the quality management system of an enterprise or organization can be maintained. Regrettably, a lot of business entrepreneurs do not understand the enormity of this assertion. Even though at recruitment, they declare the quality policy of their organization while engaging the employees, their behaviors deviate significantly from the angle of leadership. Hence, Misztal (2013) observed that procedures and rules assume the means for the settlement of employees' assigned tasks with no regard to their working conditions. Consequently, the employees become unmotivated, and as such, they work reluctantly and carelessly because they do not see a sense of fairness in their work. This attitude further result in nonconformities of products and all corrective actions may not produce or yield any positive results because they are primarily concerned about the causes and look away from the managers' personality roles.

Hamrol (2005) argued that success attainment in quality management process is only 10% dependent on technical equipment, nature of available technology (40%), and 50% on people and the way and manner they are managed. Leadership, according to Hamrol (2005) implies that the top management team should cooperate in the assessment of the strategies, the aims, and the organization's management policy. Leadership's primary goal according to Hamrol (2005) is to create and maintain internal and external conditions wherein the employees may be completely engaged to drive the objectives of the organization. It should be such that the leader should consistently plan certain activities and at the same time support the subordinates in the implementation of their duties. The principle of ethical leadership can build an organization to an enviable level. Hence, Bubble (2012) mentioned that the ethical leadership process is a significant factor used in influencing employees through values, principles, and beliefs that border on the accepted norms within organizational behaviors.

It thus appears that no one has an all-purpose and all-around definition of leadership. From the foregoing definitions of leadership, it becomes certain that leadership as a concept conjures an idea of 'one leader with multiple followers'. In a leadership book written by James MacGregor Burnes, he cites an author who has 130 different definitions of leadership. This suggests that there is no single set of universally accepted factors or processes that have identified the qualities of effective

leadership in an organization or amongst groups. Barnes & Kriger (1986) identified two (2) distinct extremes to leadership. At one extreme, they identified leadership who is equated with a leader being "a hero-person", at the other extreme exist leadership who is viewed as possessing a set of personal attributes such as charisma, energy, or peculiar style. They further identified a middle position between the two extremes which consist of the contingency theorists who argue that leadership depends upon anything ranging from tasks situations to the subordinate's expectations.

The key management's task which is driven and controlled by the organizational leadership are to identify and ascertain a workable structure, assign responsibilities, ensure effective internal and external communication, and efficient control of activities to guarantee a continuous business success. In addition, the other key components required of an effective leader includes the ability to motivate and equip the people under them through effective communication (Hamrol, 2005), manage and resolve conflicts (Myszewski, 2009), and develop creativity and technical tasks (Salmani & Bagheri, 2010).

Misztal (2013) reasoned that those personality features, which make a person a leader, make him or her unique as a person managing human resources. Where such an individual does not have the expected charisma, such a person can be regarded as a leader if and only if he or she can convince others to act in a certain expected way(s) - using appropriate interpersonal relations principle, and not through punishment or enforcing some specific goals on them. It is also argued that organizational support, maintenance culture, organizational justice, maintaining appropriate organizational structure, and the strategic approach devoted to the maintenance of human resources are significant to organizational success (Chenijani et al., 2013; Ejimabo, 2013).

To fully maximize the potentials of people working in an organization, Lindebaum & Cartwright (2010) suggests that "the top management should, through its leadership, create and maintain a shared vision, shared values and an internal environment in which people can become fully involved in achieving the organization's objectives". It can be understood that most of the factors that improve work efficiency and induces high productivity, are inside the social and emotional character of the employees. The continuous existence and survival of any organization require a concept and measurement of organizational performance review, development of technical tasks, development of creativity skills, as some of the measuring tools for the achievement of organizational goals (Harold & Montgo, 2010; DiLiello & Houghton, 2006; Nagendra & Farooqui, 2016).

Leadership requires a good measure of ethical standards. The ethical aspect of leadership connotes 'the making accurate decisions and being proactive along with credible intents that are joined with moral correctness of conducts' (González & Guillén. 2002). This ethical aspect stresses the logical as well as the practical correctness of the actions of leaders in relating with their subordinates. Rus, et al. (2010) argue that leaders who are self-centered or who are self-serving are wicked and are bad class leaders whose actions and conduct constitute consequences for followers as well as for the entire organization.

Knowledge-based business managers are conversant with the significance of involving employee using a more friendly leadership approach in place of dictatorial tactics. This friendly approach of organizational leadership normally produces positive results, which is not only measured based on human resource management parameters, but most importantly on the level of products and services quality, and the overall financial improvement of an organization.

In other to comprehensively perform the leadership role in an organization, the ten (10 features that Deming suggested in his lecture in the USA should be replicated in today's organizations (Latzko & Saunders (1998). The 10 points are that a leader should:

- Identify the extent to which group work aligns with the company's corporate objectives;
- Examine the early and late phases of a particular work process;
- Ensure that all the employees' conditions of work are improved to motivate them;
- Avoid being a judge, instead serves as a coach;
- Use figures to clearly understand the caliber of people working with him/her;
- Improve on the operational system and cooperates with all colleague employees;
- Inspires confidence on subordinates;
- Never assumes perfection;
- Listens and learns from all; and
- Empowers the employees in completing their tasks.

The concept of succession planning for employees and managers according to Cadmus (2006) is a significant factor in an organizational leadership process. It starts with making a clear vision and strategic plan. It also consists of hiring, developing, and coaching all staff to meet new competencies that are required for survival and progress. The succession planning process requires strong commitment, vigilance, and engagement by all members of the housing delivery sector.

Hurduzeu (2015) observed that effective organizational leadership is not an easy task as it involves several actions to be taken by the leader, and such actions include employee motivation, staff management, encouragement, inducement, remuneration, and personal analytical skills. The study further stressed that the leadership qualities will result in an increased staff's commitment resulting to higher productivity and profitability.

Similarly, Sila & Ebrahimpour (2005) mentioned that the cumulative effect of effective leadership on organizational performance was innumerable ranging from a high rate of turnover, increased job performance, organizational effectiveness to the efficient cost and quality management. The leadership process is a strong factor that influences relationships in an organization (Hollander & Julian, 1969).

Notwithstanding the myriads of conceptualizing leadership as an area of organizational research, certain key ideas stand out as the

most critical components that are central in describing organizational leadership, and they include: Leadership is regarded as a very dynamic process; Leadership is a concept that comprises of influences, intelligence, and perseverance; Leadership normally occur within the confine of a group context; Leadership deals with personal assessment and development; and finally, Leadership involves setting and attainment of goals timely and within a stipulated budget, and of specific quality. From the foregoing, it can be concluded that leadership is a dynamic process primarily concerned with influencing subordinates to perform optimally. It is therefore appropriate to handle the leadership issue in the housing organizations as an input required for the implementation and sustenance of adequate housing delivery.

2.1 Styles Of Leadership

Leadership is a practice of social influence where the leader solicits directly or indirectly for the voluntary cooperation, support, and participation of subordinates to reach or even surpass organizational goals and objectives. Leaders delegate and influence others to act in such a manner and process as prescribed to fulfill some specified objectives. Hersey, et al. (2001) opined that the style of leadership is the most significant factor in the organizational leadership process. They argued that leaders acquired their styles of leadership through training on one hand, and experience on the other hand. The leadership style employed in an organization can improve or reduce the productivity and growth of such an organization. Judge and Piccolo (2004) argued that effective leaders inspire, motivate, and boost the morale of the employees who in turn are encouraged to put in their best towards the good of the organization.

Several styles of leadership have been identified in the literature. For instance, Bass (1999) categorized leadership style into two (2) main categories which include transformational leadership, and transactional leadership. Transformational leadership according to the study has intellectual stimulation, individual influence, and spiritual encouragement as its distinctive features. Transformational leadership style especially considers individual participation, has an established vision and aim, and has a culture that is open and transparent, has trust and confidence in the staff to reach their individual goals, and also ensures that employees reach their maximum potential. On the other hand, transactional leadership according to Bass (1999) is concerned about employees' basic and external demands; about the relationship existing between leaders and subordinates in an organization. Transactional leaders tend to realize the goals of an organization through the performance of some specific roles, and effective design of organizational mission statement. The primary goal of transactional leaders is to entrench and sustain an enduring organization.

Bass & Avolio (1990) opines that transformational leaders normally encourage subordinates to have a different perspective about challenges; they provide necessary supports and encouragement, communicate the vision and mission to all employees, create passion, and identify with all. In Bruce et al. (1995), transformational leaders normally define and communicate the vision and mission of their organizations, and identify a suitable style of leadership that can "influence" and or "transform" individual members of an organization. They stressed that this could be achieved through a sustained motivation, through mediating any possible conflict among team members. According to Podsakoff et al. (1990), transformational leadership has an overwhelming influence on both individual employees and organizational outcomes by way of job satisfaction and higher performance.

Yang Jen-Te (2007) mentioned that transactional leaders use the concept of motivation to influence their subordinates. This is accomplished in the form of an "exchange" mechanism, where for instance, accomplishing a task is rewarded. In a study by Kahai et al. (1997), it was revealed that teams' effectiveness was higher when the transactional leadership principle was applied. Mitonga-Monga, et al. (2012) observed that transactional leaders focus more on task completion and staff compliance, and more so, they rely substantially on the principles of rewards and punishments to influence the performance of staff.

Jony et al. (2019), in their study on the influence of leadership styles on organization success identified three broad categories of leadership styles, and they include autocratic, democratic and laissez-faire leadership styles.

Autocratic leadership style is described as a leadership style that is purely based on an individual's control over the affairs and actions of members of the team, with little or no input by the team. Autocratic leaders according to Cherry (2019) take a decision based on their conviction, and they rarely involve or consult their subordinates in decision making. Al-Khajeh (2018) noted that leaders with this style of leadership normally expect those under them to act as commanded without any option of opposing or airing their views. The autocratic style of leadership may not be a bad style of leadership as it sounds. Armstrong (2012) mentioned that the style is required and necessary in an emergency, and where the employees are homogeneous. Also, Bhargavi & Yaseen (2016) argued that it is appropriate to act autocratically in certain circumstances, such as during a crisis where there is a need for quick restoration of normalcy in the organization.

Democratic style of leadership is another popular leadership style employed in organizational management. This style of leadership is otherwise referred to as the participatory or collective style of leadership. Cherry (2019) mentioned that the democratic style of leadership allows team members to contribute and participate on issues for the good of an organization. Puni et al. (2014) argued that under democratic leadership, decision-making is decentralized, and followers are allowed to make input for the progress of an organization. This position was supported by Sadia & Aman (2018) who believed that followers could give intelligent ideas that will tremendously benefit an organization. However, the democratic style of leadership was criticized by Nwokocha & Iheriohanma (2015) who argued that decisions made by the subordinates may be poorly conceived and if implemented may affect the growth of an organization.

The laissez-faire style of leadership, on the other hand, is a leadership style where organizational leaders work together and empower team members to take part in decisions making process (Cherry, 2019). This leadership style has been criticized by Bass & Bernard (1985). They argued that a situation where leaders do not trust or believe in their leadership ability, instead allows their subordinates to make decisions, will no doubt put a lot of pressure on the subordinates. Jony et al. (2019 described this style of leadership as a situation where organizational leaders refuse to make decisions themselves. Puni et al. (2014) suggested that organizations should not invest in the advancement of laissez-faire leaders since they believe that employees can take care of themselves. However, Dalluay (2016) noted that laissez-faire leadership style can result in employees' unhappiness leading to unproductivity and inefficiency.

2.2 Influence Of Leadership On Organizational Management

Due to globalization, commercialization, and the complexities of today's business, there is a greater need for efficient leaders who recognize the complexities within the dynamic global business environment. Nanjundeswaraswamy & Swamy (2014) observed that if the organizational tasks are sufficiently structured, and there is a cordial relationship between the leader and the subordinates, employees' effectiveness will be high. Mullins (2007) observed that democratic leaders involve all members of the team (all employees) and motivate them for efficiency.

It has been argued that leaders wield great influence over the well-being or otherwise of their subordinates (Kelly & Barsade, 2001; Bono et al., 2007). Customary theories around leadership like the 'traditional influential theories of leadership contain an aspect of the emotional component. Here, leaders create a joint emotional experience that bonds team members together and induces high productivity. In Baeza, et al. (2009) for instance, it was revealed that leadership charisma has a great influence in the promotion of a positive team atmosphere and averting negative effective working conditions.

Having the capacity to influence others is a vital skill in the leadership process. According to Kouzes & Barry (1995), to influence means to have a domineering impact on other people's psyche, behaviors, attitudes, opinions, conducts, and choices. Influence is not synonymous with the power of control, as it does not connote an act of manipulation of others to have your way. Rather, it has to do with the ability to identify those factors that motivate and boosts employee commitment, and then employing such knowledge to leverage work performance thereby resulting in higher productivity. The ability of a leader to influence others is based on several factors. Todorovic (2020) identified 6 leadership influence attributes that can help an organizational leader to become more effective and those attributes include: attitude, value, connection, passion, openness, and timeliness.

Several past studies exist on the influence of leadership on organizational management. For example, Bass & Riggio (2010), Kouzes & Posner (2007) and Yukl (2009) identified the influences of leadership on organizational performance. Bass & Rigio (2010) classified leadership into 4 broad parts which include: charismatic leadership, inspiration leadership, intellectual stimulation leadership, and individual leadership consideration. Charisma, according to Bass & Rigio (2010) is significant in influencing workers' performance and behavior because it helps in developing a connection between the leader and the led (subordinates). People are attracted and influenced by what they see, observe or feel. Charisma can be measured based on attitude, character, behavior, actions, and reactions portrayed by an individual. It also involves gaining and building the trust, respect, and confidence of others.

Inspirational leadership has received wide discussion. At its very core, inspirational leadership is generally about looking for ways that will enhance the potential of the subordinates in such a manner that works best for them, and others will be inspired to push themselves further and harder to achieve more and reach their potential. Though the technique to do this might differ from organization to organization or from individual to individual, but the overall result will always be the same (Finney, 2019). This suggests that is a process where people (workers) develops strong confidence in what they are doing and using this confidence in such a manner that it will profit the organization that engages them. For organizational leaders to push their organization to the level of success expected, they of necessity need the buy-in (inspire) of all employees since they are the drivers of an organization.

From the angle of organizational leadership, Rafferty & Griffin (2004) observed that intellectual stimulation is understudied. Nevertheless, they pointed that leadership has strong influence on team process, such as in employee's learning. They stressed that, with intellectual stimulation, organizational leaders constantly encourage members of a team to think outside the box by performing in innovative ways. This, according to the study can be realized by working on their personal beliefs and upholding and embracing new and innovative procedures. Likewise, it has been established that leaders who impart positive psychological and emotional behaviors assist their teams to enhance work performance and general well-being of the workforce and the organization (Pirola-Merlo, et al. 2002 and Salanova et. al., 2012).

Other studies on leadership reported that some behaviors displayed by leaders have a significant effect on employees' confidence and interest (Bonoet, al. 2007), emotional commitment (Rafferty & Griffin, 2004), and that it can assist in creating a positive team condition (Baeza, et al. 2009). Broaden and Build theory suggests that positive affectivity such as emotions, feeling, etc. broadens peoples' modes of thinking, reasoning, and action, and hence builds enduring resources such as cognitive, social, etc. (Fredrickson, 2001; Sekerka & Fredrickson, 2008).

Also, studies have revealed that team positivity has a strong influence on team dynamics, behaviors, attitudes, and overall performance (Collins et al., 2013). Intellectual stimulation as pointed by Rafferty & Griffin (2004) may have a strong positive or negative effect on the reactions of a team, and may manifest in

their level of commitment, judging from their perception of how their leaders value their contributions. Therefore, intellectual stimulation has the capacity to arouse teams' learning process by imparting positive affect and reactions on them, which again can assist them to be positively engaged in group learning.

Leadership based on individual perspective, effective leaders should pay serious attention to the actions, needs, and expectations of the subordinates, and also delegate responsibilities while providing sufficient guidance, mentoring, and coaching in the process of executing the delegated tasks. According to Walumbswa, et al. (2005), organizational leaders normally use a 'situational approach' to practice different leadership styles with consideration given to the levels of subordinates' maturity. This position supports the argument portrayed in Hersey et al. (2001) to the intent that the level of maturity of the subordinates determines the style of leadership to be employed by the leader. They further stressed that effective leaders could adapt any of the following leadership approaches: (a) directing – a process where the leader uses one-way communication to inform their subordinates. (b) Selling and coaching – a process where the leader uses a two-way communication approach to reach out. In this approach, leaders and subordinates come to terms with what to do or what not to do. (c) Participating style – Here, the leaders are seen as just supportive and work together with the subordinates. (d) Delegating approach – In this case, there is very little involvement of the leader.

To fully understand organizational leadership influence, leaders must clearly define the future of the organization through articulated and well-defined vision and mission, knowing how the company future should look like, aligning activities and programs with the stated vision, and motivating all to ensure the realization of the company goals, notwithstanding the obvious challenges. It is expected that organizational leaders should master the act of leading and managing, without which the business will head for extinction due to adverse threats that are common to businesses (Kotter, 1990).

The continuous business threats, complexities, and challenges as found in the housing delivery are indicators that there is a need for the development and implementation of the effective policy by housing organizational leaders. Studies have shown that leadership influence plays a significant role in effective management of organizational activities, such as favorable working environment, the building of trust to assist in the development of effective communication and openness among employees and management; among superiors and their subordinates; among industrial unions and management; and between the employers in the organization (Thomas et al. 2009).

2.3 Re-Conceptualizing Adequate Housing Delivery (AHD)

Determining the effectiveness of the housing delivery system and constructing suitable standards to satisfy requirements of projected objectives are very fundamental to the problem of adequacy.

The concept of adequate housing has been differently defined and interpreted by authors and researchers. In Eggers and Moumen (2013), housing adequacy is described as a situation where there is a complete and total absence of physical, spatial, and service anomalies within the dwelling unit and around its immediate surroundings.

Ibem and Alagbe (2015) considered adequate housing as the residential environment that is qualitatively and quantitatively suitable in fulfilling the needs, desires, expectations, and aspirations of users. Further, Ibem et al. (2012) contend that to objectively assess housing adequacy a comprehensive assessment of the availability or non-availability of housing services and management practices, basic social infrastructures, and the physical and spatial characteristics of housing units are required. UN-Committee on Economics and Cultural Rights (1992) stated that "housing deficiencies would not only be solved by expanding the quantity, but it should also embrace qualitative adequacy and accessibility of housing.

Qualitative adequacy of housing entails moderate design, adequate space, sizeable rooms, legal occupancy, adequate security, access to social infrastructural facilities (road, water, electricity, schools, hospital etc.), place of work and market (Atati, 2014). Nonetheless, the UN-HABITAT (2006) argues that what constitutes adequate housing differs from one place to another and depending on existing social-cultural, environmental, political, and economic norms. The implication of this therefore is that housing adequacy is a divergent construct determined by multiplicity of factors. Therefore, in real term adequate housing to one may be in-adequate to the other depending on the perception of an individual.

In addition, there are human established and non-measurable functions or activities which affect the sense of adequacy. Xiaolong et al. (2016) argue that "public facilities, housing policies, housing amenities, housing internal design, housing indoor quality and safety, building external design and landscape, housing affordability, and facility management style" are the components that determines housing adequacy.

Similarly, Kitila (2019) identified accessibility, services, facilities, and quality management as the key challenges to housing adequacy. The study further stressed that "a decrease in the accessibility of housing sites is directly associated with a decreasing number and quality of infrastructural and social services provided". Also, Rapoport, (2001) identified such functions as security, available opportunity, and identity as indices to measure housing adequacy.

Ochieng (2015) outlined specific classified attributes as the basis for measuring and determining housing adequacy:

Attribute One: Housing unit- in terms of type of accommodation, space, size, occupancy ratio.

Attribute Two: Housing setting - in terms of the environment, functionality, quality of finishes, facilities provided, and management style.

Attribute Three: Number produced - in terms of quantity benchmarked against effective demand/supply

Attribute Four: Delivery process - in terms of overall efficiency of the delivery system.

2.4 Factors Influencing Adequate Housing Delivery

To identify the factors that contribute to adequate housing delivery is highly important given that there are few studies in relation to this area of study, and more importantly, several of them failed to identify a comprehensive list of the factors. For example, Zyed et al. (2016) while examining young Malaysians housing affordability as a critical problem, failed to provide those possible factors that influence the delivery of housing. Also, Olanrewaju and Woon (2017) did not consider 'household income in relation to rental cost and housing price' as a factor that influences adequate housing delivery, which Ibem and; Amole (2013) considered as important factor influencing housing demand in every society. Likewise, the study by Mulliner and Maliene (2015) failed to consider transportation cost in relation to the income of the household among the factors examined.

Additionally, Olanrewaju et al. (2018) in their study considered price and functional utility (tangible) and symbolic, emotional, cultural, and social (intangible) as factors influencing adequate housing choice and delivery. The study however failed to consider the significant roles played by the environmental factors on housing delivery efforts. Therefore, this section identifies the key economic, social and environmental factors necessary for the delivery of adequate housing as viewed in ast studies. For instance, Maina (2013) noted that transportation cost in relation to income, taxation and subsidy influences the adequacy of houses delivered, Also, household income level (Coolen, 2002), security of tenure (Gan et al., 2019), accessibility [Jansen, 2012],housing quality/adequacy (e.g., meeting decent home standards (Wiedmann et al., 2019), safety/security (reduced incidence of crime and criminality) (Ross et al., 2010), were identified as important factors that influence adequate housing delivery.

Similarly, factors such as suitability or type of architectural design (Ross et al., 2010), access to recreational facilities, e.g., parks, green open spaces (Charoenkit and Kumar, 2014) effective maintenance and management of properties [Babalola et al., 2019], household size, unit size (Maliene and Malys, 2019), clean and attractive environment (Aliu et al., 2018, number of bedrooms needed (Tibesigwa et al., 2017) have been identified as key factors influencing housing delivery. Likewise efficient waste management and energy efficiency, access to recreational/leisure facilities were identified by Wiedmann et al., (2019] as significant factors affecting the delivery of adequate housing, On the other hand, access to health facilities (Muazu and Oktay, 2011], lighting quality, e.g., day lighting (Olanrewaju and Woon, 2017), and type of materials used (Gan et al., 2019] were equally considered as relevant factors to the delivery of housing. Similarly, in a study on the severity of factors influencing housing choice, Ezennia and Hoskara (2019) identified housing price in relation to household income, type of building, e.g., apartments, condominiums, semi-detached, etc., and housing location, e.g., City, countryside, etc.as some of the key factors that influence affordable housing delivery in Nigeria.

3. Methodology

The main objective of this study is to identify and assess the factors influencing organizational leadership for adequate housing delivery (AHD) in Nigeria. The study objective is qualitative as it was meant to explore the opinions and views of experts in the housing industry, who have had a sufficient degree of professional experience in housing delivery.

The primary reason for adopting the Delphi research approach in this current study was because of its ability to solve a complex human problem as reported in (Skulmoski et al. 2007). The experts selected and used in this study critically analyzed the identified factors underlying this study, and by so doing made their opinion on the subject known to the researchers based on their professional experiences on the subject under discussion. The individual opinions of the experts helped in reaching a consensus on the factors influencing organization leadership for adequate housing delivery. The Delphi study approach is normally adopted in a complex study, particularly where human ideas and opinions are sought as noted in Agumba & Mosunda (2013).

3.1 Selecting The Panel Of Experts

Experts for the Delphi study were selected based on their professional experience and deep knowledge in the field of housing delivery. They were drawn from the academia and the housing industry. The concept of Seuring & Muller (2008) was used in the selection of experts for this study. They suggested that experts should be drawn among those with requisite knowledge of the subject under study. These experts were selected across the major state capitals in Nigeria, particularly from those states that are noted for massive real estate development, and they include Lagos, Abuja, Port-Harcourt, Enugu, Kaduna, Yola, and, Akure. The selection of these experts was a rigorous exercise, but it allowed the harvesting of intelligent opinions and ideas that are relevant to the study from the experts notwithstanding the rigors.

The study questionnaires were designed and unanimously distributed to avoid any conflict of interest. Due to the global pandemic, covid 19, the distribution of the questionnaires was made electronically using emails and what Sapp platforms. The condition to be selected as an expert includes but not limited to: such a person must be an expert in the field of housing; must have been a registered member in a professional body related to housing industry; must have sufficient communication skills; and must have proven knowledge of housing design, construction and management.

The study used 2 iterations of the Delphi process before arriving at a consensus. Each of the rounds took up to 30 days to be completed. In the first round, the experts were allowed the option of selecting from the already identified and outlined organizational leadership factors. They were required to rate the influence of the factors on adequate housing delivery (AHD) using a 10 point scale ranging from "no influence" to a "very high influence". The result obtained from the first round was thereafter used to structure the second round, in which case the experts were required to reconsider their earlier decisions and make a change if they so wish. This was made possible by comparing their original opinion with the group median (M) as obtained from round 1.

3.2 Arriving At A Study Consensus

The consensus obtained in this study was made possible by adopting an arithmetic mean ($\bar{x}$) principle. This is because arithmetic means can account for all the variables in the data set as found in McDonald (2009). This approach has been equally used in past studies such as Green, et al. (1990); Aigbavboa (2014), and Somaiah (2019). These studies showed that to arrive at a consensus, the mean rating should be categorized in any of the following ways: very important, at least 90%, important ranges from 80-90%, unimportant, ranges from 70-79%, and very unimportant ranges from 69% and below. Similarly, Njuangang et al. (2017) suggested that to arrive at a consensus, a mean score value of at least 80% must be attained. Lumus, et al. (2005) on the other hand stated that a consensus is achieved in the Delphi study if a means ($\bar{x}$) rating of at least 7 is achieved.

In this study, the approaches used in Aigbavboa (2014) and Somaiah (2019) were adopted to arrive at a consensus. The influence factor mean for each variable was calibrated and ranged between good and strong consensus using interquartile deviation (IQD) as demonstrated below:

Strong consensus = median (M), 9-10; mean ($\bar{x}$), 8-10; IQD, ≤ 1

Good consensus = median (M), 7-8.99; mean ($\bar{x}$), 6 - 7.99; IQD, ≤ 2

Weak consensus = median, ≤ 6.99; mean ($\bar{x}$), ≤ 5.99; and IQD, $\geq 2 \leq 3$

4. Results and Discussion

4.1 Results

Despite various criticisms surrounding the reliability and validity of the Delphi method of research, the method is widely used particularly in human-related studies. To ensure the reliability and validity of the method, the study ensured that all the experts selected for the study clearly and unambiguously understood each of the factors influencing organizational leadership for housing delivery, and as indicated in the study.

The first page of the study questionnaire is the expert assessment survey which highlighted issues on how to correctly answer the questions. It contains items such as years of professional experience, knowledge of housing delivery mechanisms, professional membership status, level of academic qualifications, level of interest to take part in the Delphi study, and the number of paper publications where applicable. This expert survey assessment was used in this study to identify those that qualify to take part in the study.

Using the approach of Aigbavboa (2014), the validity of the experts was determined by allocating specific points to each criterion, any experts who scored a cumulative point of less than 40 will be eliminated and adjudged not to be qualified to take part in the study. However, before the screening and final selection of the experts, 36 experts were identified and qualified to serve as experts in the first round of the study, as they all passed the set criteria.

From the information extracted from the expert responses, it was revealed that the experts are residing in the 6 geo-political zones of Nigeria which are North East (NE), South East (SE), North West (NW), South West (SW), South-South (SS), and North Central (NC). Seven (7) of the experts resides in Lagos (SW), 7 in Akure (SW), 9 in Abuja (NC), 4 of them resides in Port-Harcourt (SS), 3 resides in Enugu (SE), 4 of the experts resides in Kaduna (NW) while 2 of them resides in Yola (NE) of Nigeria. Concerning the expert's years of experience, the study revealed that 6 of them have had experience between 1 to 5 years, 8 of them have experience spanning between 6 – 10 years, 11 of the experts have had between 11 - 15 years of professional experience, 7 of them were found to have had between 16 to 20 years cognate experience, while 4 of the experts indicated that they have had an experience of 21 years and above.

In regards to the sector where the experts work, the study revealed that 13 of the experts work as academics, 16 of them were in the organized private sector (real estate industry), while 7 of the experts were in the public sector organizations (ministries and agencies related to real estate). On the expert's educational qualification, the study revealed that 10 of the experts possess Ph.D. qualification, 19 of them hold MSc. Degree or its equivalent, and 7 of them were holders of Bachelor's degree or its equivalent. When the expert's area of specialization was considered, it was revealed that 6 of them were Estate Surveyors and Valuers, 10 were Architects, 8 of them were professional Builders, and 4 of the experts were Quantity Surveyors, while 5 and 3 of the experts were construction project managers and Civil Engineers respectively.

Results obtained from the computations for the round 2 of the Delphi showed that it was not necessary to proceed to another round of the study since further values cannot be added to the already attained consensus as obtained in the second round. Table 1 show the consensus result obtained from the expert panelists. In addition to the Delphi method used, the study employed both an online survey in which a single link was sent out to the potential respondents, and a physical administration of questionnaire to those who are unable to respond through the Google form. A total of six hundred and twenty eight (628) respondents completed and returned the questionnaire. The data obtained was downloaded and entered and analysed using SEM-PLS method for further analysis, in which case 481 was found suitable for use.

Table 1: Delphi analysis of the factors influencing organizational leadership for AHD in Nigeria

Leadership factors	Median (M)	Mean ($\bar{x}$)	Standard deviation (σx)	Interquartile deviation (IQD)	Mean score ranking (R)
Organizational sustainability	9	9.00	0.52	1.00	1
Effective communication	8	7.64	1.34	1.00	14
Leadership process	7	6.86	0.77	1.00	18
Ethical consideration	8	7.86	1.59	1.00	8
Organizational performance review	8	7.71	0.99	1.00	12
Societal responsibility	7	6.64	1.08	1.75	19
Succession planning	8	7.64	1.22	1.00	13
Employees motivation	9	8.57	0.51	1.00	2
Friendly approach of leadership	7	6.93	1.38	2.00	17
Maintenance culture	8	7.79	0.80	1.00	9
Maintaining appropriate organizational structure	8	8.00	0.68	0.00	5
Management of conflicts	6	6.00	1.04	2.00	20
Development of creativity skills	8	7.64	1.60	1.00	13
Development of technical tasks	9	8.50	0.52	1.00	3
Creation of organizational vision	8	8.07	0.73	0.75	4
Maintenance of organizational vision	8	7.93	0.73	0.75	6
Maintaining high sense of fairness among the employee	8	7.86	0.86	0.75	8
Inclusive leadership style	8	7.79	0.70	1.00	10
Unity of purpose and direction	8	7.93	0.74	1.00	6
Commitment in taking initiatives	7	7.36	0.84	1.00	16

M=Median; $\bar{x}$ =Mean; σx =Standard Deviation (SD); IQD=Interquartile Deviation

From the twenty (20) identified factors that influence organizational leadership for adequate housing delivery, three (3) of the factors consisting of organizational sustainability, employees motivation, and development of technical tasks have a very high influence (VHI: 9.00-10.00) for adequate housing delivery, while sixteen (16) factors - leadership process, effective communication, ethical consideration, organizational performance review, societal responsibility, succession planning, friendly approach of leadership, maintenance culture, maintaining appropriate organizational structure, development of creativity skills, creation of organizational vision, maintenance of organizational vision, maintaining a high sense of fairness among the employee, inclusive leadership style, unity of purpose and direction and commitment in taking initiatives have a high influence (HI: 7.00-8.99). Only one (1) factor - management of conflicts has a medium influence (MI: 5.00-6.99). None of the identified factors was found not to influence adequate housing delivery. Also, from the IQD scores, it was revealed that strong consensus was achieved for seven-teen (17) factors whose score values range from 0.00 to 1.00, and as indicated in table 1.

However, in terms of their respective standard deviation (σx), eleven (11) of the factors recorded strong consensus showing consistency in the experts' responses as their standard deviation (σx) values was at most (1.00). Nevertheless, three (3) of the factors attained a good consensus with their score values ranging from 1.10 to 2.00. The values for their standard deviation (σx) revealed inconsistency and variability in seven (7) factors drawing from the response of the expert panelists as their respective standard deviation (σx) was more than one (1). In terms of ranking, the factors were ranked by their respective mean ($\bar{x}$) scores values.

The study revealed that organizational sustainability was ranked 1st with a mean score value of 9.00, a standard deviation of 0.52, and an IQD of 1.00 out of the 20 factors that were measured. This was followed by employees' motivation which ranks 2nd with a mean score value of 8.57, a standard deviation of 0.51, and IQD of 1.00; while management of conflicts ranked last (20th) having a mean score value of 6.00, a standard deviation of 1.04, and IQD of 2.00.

From the above result, as obtained from the Delphi study, it can be concluded that a leader's decision to sustain an organization, and sufficiently motivate the employees would have a great influence on organizational leadership and management in the housing delivery.

To validate the result obtained from the Delphi study, the researchers embarked on a field research and examine the data characteristics by investigating the organization and leadership variables. After removing the data points identified as outliers, it is revealed that the samples left to

be analysed was 481. These values are displayed in the Table 2 below.

Result from Table 2 indicates the organizational leadership and management features in terms of percentage responses on a scale of 1 to 5, where 1 is to no extent (not at all influential), and 5 is very large extent (very influential), and a mean score (MS) ranging between 1.00 and 5.00. All the mean scores are above the midpoint score of 2.50, which indicates that all the respondents agreed with organizational leadership and management features of adequate housing delivery. It is notable that eleven of the organizational leadership and management features have a MS > 3.00 ≤ 5.00, which indicates that 92% of the respondents perceive the organizational leadership and management features are significant in driving adequate housing delivery in Nigeria.

Table 2: Organizational Leadership and Management features

Attributes	Mean	Std.	Rank
Effective communication	4.33	.743	3
Leadership process	4.49	.716	2
Ethical consideration	3.52	.861	8
Organizational performance review	4.59	.620	1
Succession planning	3.30	.997	11
Employees motivation	3.78	.982	7
Maintenance culture	2.81	1.327	12
Maintaining appropriate organizational structure	3.98	1.036	6
Development of creativity skills	3.32	1.198	10
Development of technical tasks	4.06	.948	4
Creation of organizational vision	3.39	.947	9
Maintenance of organizational vision	4.06	.815	4

Source: Fieldwork (2022)

In this research, the Composite Reliability (CR) values, presented in Table 3, are found to be 0.858. Therefore, the results in this regard indicate that the condition for composite reliability was achieved. The study also uses AVE to measure its convergent validity. AVE is the average variance extracted shared between variables and their measures. Couchman and Fulop (2006) suggest that AVE's value for a variable should be higher than the variance shared between variables, especially with other variables. Nevertheless, Barclay et al. (1995) proposed 0.50 as the AVE rule of thumb. The AVE and the composite reliability (CR) values for the organizational leadership and management variables are presented in Table 3. Furthermore, the table presents the items' loadings. The retained items present items with loading greater than 0.4, while those less than 0.6 are eliminated to achieve the desired AVE of 0.5 (Hair et al., 2014).

Table 3: Factor Loadings, Composite Reliability, and Average Variance Extracted for the Constructs

Endogenous Constructs	Items/indicators	Items loadings	Cronbach's Alpha	Composite Reliability	AVE	Discriminant validity
Organization Leadership & Management	Creation of organizational vision	0.847	0.782	0.858	0.603	Yes
	Succession planning	0.633				
	Maintenance culture	0.793				
	Development of creativity skills	0.818				

Source: Fieldwork (2022)

4.2 Discussion

This study was to determine the extent to which adequate housing delivery in Nigeria is influenced by organization's leadership and management. The result obtained from SEM results on this exogenous variable revealed that the inter factor correlations and the average value extracted (AVE) for organization leadership and management latent factor were large and statistically significant; suggesting a high degree of linear association between the indicator variables and the endogenous construct. Again, the inter factor values for organization leadership and management suggest that the latent variable considerably predicted the endogenous factor construct. More so, an examination of the total variances accounted for in each measure by the endogenous variable revealed that the scores were also valid. The indicator variables used in measuring organization leadership and management construct were highly relevant to the endogenous variable. The relationship between organization leadership and management indicators and adequate housing delivery was also found to be valid. Therefore, the overall results suggested that the influence of organization leadership and management in determining overall adequate housing delivery in Nigeria is direct and statistically valid (see Table 2).

Likewise, the descriptive statistics in Table 2 revealed that an aggregate percentage of 76.5% of the respondents found organization leadership and management (with extent of

influence ranging from 'not influential' to 'high influential', while only 0.21% of the respondents were of the view that organization leadership and management has no influence on adequate housing delivery. Hence, both the inferential statistics and descriptive statistics indicates that organization leadership factor have a direct influence on quality assurance management for adequate housing delivery in Nigeria. This is consistent with the findings of Day and Lord (1988) and Hogan and Kaiser (2005) that good leadership promotes effective group performance.

In relation to the construction industry, Olsen (2001) informs that subordinates and the followers will not be committed upon discovering that leader(s) in an organization are not effective and efficient, thereby resulting in product poor quality performance. Juran (1951) found that leadership in an organization through the concept of planning; control and improvement are influential factors in determining quality management.

However, it is argued that the best and the most credible approach to leading and effectively managing an organization such as the housing delivery operations for optimum quality outcomes is to clearly understand the organizations' uniqueness and intricacies; its growth strategy, success rate, and goal accomplishments which are based on the organization's policy, mission, and vision (Nelson & Quick, 2003; Hogan & Kaiser, 2005; Ejimabo, 2013). Likewise, it has been established that leaders who impart positive psychological and emotional behaviours assist their teams to enhance work performance and quality product outcome (Pirola-Merlo, et al. 2002 and Salanova, et. al., 2012). It has been mentioned that leadership is pre-condition through which the effectiveness of an enterprise or organization can be maintained (Misztal, 2013).

The findings further suggest that organizational leadership and management is a significant determinant of adequate housing delivery. Therefore, companies without effective leadership end up delivering poor quality products. Further, the findings showed a different position towards organizational leadership and management in adequate housing studies. The cumulative effect of the four variables that define organizational leadership and management are peculiar only to this study.

5. Conclusion And Recommendation

The study evaluated the factors influencing organizational leadership for adequate housing delivery in Nigeria. The objective of the study was achieved with the use of the Delphi method of research using a quantitative approach. The knowledge, opinions, and experiences of experts in the field of housing were used in realizing the research objectives. In the study, a consensus was reached on all the 20 factors identified and measured using the criteria set for the Delphi study. The study, therefore, concludes that due to the high level of conflicts, competitions, and rivalry going on in organizations because of their quest for dominance and relevance, there is the need for organizational leaders in the housing industry to re-strategize and develop sufficient knowledge on those factors that would enable them to achieve adequate housing delivery to the satisfaction of the final beneficiaries. This finding is in agreement with the position of Bruce, et al. (1995) who affirms that a suitable style of leadership can "influence" and or "transform" individual members of an organization.

Findings from the study revealed that factors such as organizational sustainability, employee motivation, technical skills development, and creation of organizational vision were among the most significant leadership factor influencing adequate housing delivery in Nigeria.

The study, therefore, suggests that effective leadership mechanisms such as subordinate's participation and sustenance of organizational vision should be put in place by leaders in the housing industry to initiate processes that would ensure the delivery of adequate housing. Also, the study recommends that continuous efforts should be employed by leaders to motivate their subordinates in order to encourage them to perform in line with the policy objectives of the organization. Additionally, the study recommends that leaders should develop and deploy those with innovative technical skills. It is further recommended that this study should be conducted in other countries with experts in the housing industry using the Delphi method. This will create an opportunity in identifying other factors influencing organizational leadership for adequate housing delivery.

Acknowledgements

The authors sincerely acknowledge all the housing experts from the academia, industry, departments and agencies of government and non-governmental organizations for their unquantifiable contributions of their valuable time knowledge and other resources towards the success of this research.

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IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 17-29

Planning Approval Process: An Analysis of Property Developers' Experiences in Southwestern Nigeria

Nathaniel Oluwaseun Ogunseye
Department of Urban and Regional Planning, Faculty of Environmental Studies, Olabisi Onabanjo University, Ago-Iwoye, Nigeria.

ABSTRACT

Globally, development control is one of the main activities of the planning agencies aimed at ensuring sustainable development in human settlements. Previous studies primarily explored compliance with planning regulations whereas issues of awareness, satisfaction, and willingness to participate have not been adequately dealt with. This study evaluates the property developers' experiences with the planning approval process (PAP) in southwestern Nigeria. The specific objectives are to (i) probe property developers' awareness of the legality of the PAP, (ii) examine property developers' satisfaction levels regarding the PAP, (iii) determine property developers' willingness to participate in PAP discourse, and (iv) examine problems associated with the PAP. Purposive and convenience sampling techniques were adopted to elicit data from 96 respondents using a structured questionnaire. Data were analyzed using both descriptive and inferential statistics. Major findings showed that 68.8% of the developers were aware of the legality of PAP, 70.8% expressed satisfaction with the PAP, and 78.1% were willing to participate in public discourse about PAP. Fishers' Exact test revealed that the location of developers (χ^2= 6.907, p=0.025) and gender (χ^2= 0.000, p=0.023) were significantly associated with developers' awareness of the legality of PAP. The Spearman Correlation test indicated a significant association between developers' satisfaction with PAP and their support for seeking planning approval (r=0.339, p=0.001) as well as planning approval processing time (r=0.250, p=0.026). The study recommends aspects of PAP the planning agencies need to improve upon towards achieving sustainable PAP. The study outcome will be useful for policy formulation in areas of education and awareness creation, planning approval processing time, and procuring documents required by the planning agencies. Addressing these issues will mean property developers will derive greater satisfaction from planning agencies' services and will be inspired to participate in planning matters.

Article History

Received : *30 May 2022*
Received in revised form : *05 October 2022*
Accepted : *02 December 2022*
Published Online : *31 December 2022*

Keywords:

Development control, Physical planning, Planning approval process, Property developer, Nigeria

Corresponding Author Contact:

ogunseye.oluwaseun@oouagoiwoye.edu.ng

DOI: 10.11113/ijbes. v10.n1.994

1. Introduction

Development control is an integral part of physical planning (Wahab, 1988) and is widely executed globally. It can be traced to the United States in the 19th century in New York City. Then it was deployed to achieve an effective master plan for certain areas by applying diverse control mechanisms comprising land-sub division regulation, zoning ordinances, and restrictive covenants. However, in Britain, it emerged by the enactment of an act of parliament, Cap 54 of 1933 (Ogundele, Ayo, Odewumi, & Aigbe, 2011). In Ghana, it dated back to 1859 when the Municipal Ordinance of 1859 was promulgated to regulate spatial development in municipalities comprising Accra, Cape Coast, and Sekondi-Takoradi (Ahmed & Dinye, 2011). For Sri Lanka, development control can be traced to the introduction of the Municipal Council Ordinance of 1865 and the Sanitary Ordinance

of 1882 (Dissanayake, 1987). In the case of Nigeria, it was argued that development control predates the colonial administration when traditional rulers in different regions oversee development by employing traditional methods of environmental control measures (Oyesiku, 1988; Obabori, Obiuwevbi & Olomu, 2007). Though these measures were not written regulations (Odugbemi, 1993 cited in Oyesiku, 1998), it was based on native law and custom under customary law, which thus made them legal. However, a formal attempt to control development was first made in Lagos in 1862 when the Town Improvement Ordinance was enacted (Onokerhoraye, 2006; Oyesiku, 1998; Oyewale, 2001). But the legal prescription for the building was believed to commence in 1960 with a law known as Western Region Law of Nigeria 171 of 1960, which was concluded to have emerged from the Public Health Law No. 24 of 1957 and the Local Government Law of Nigeria No.12 of 1957. One of the main thrusts of the law was that "no building should be erected without a building plan, duly certified by the health officer, the works' supervisor and the town planning authority, and no person may utilize more than half of the total building plot for the building" (Agbola & Alabi, 2010, p. 4). Consequently, development control is defined as the process of ensuring that developments are carried out as approved by the local planning authority to ensure that building and land subdivision (layout) plans are implemented as approved by the local planning authority (Obateru, 2005). For the local planning authority to exercise this legal right, development control utilizes some instruments such as building and land subdivision regulations (Obateru, 2005). These regulations or bye-laws are termed planning or space standards. However, this prelude suggests that development control "covers everything for which planning permission is needed" (Keeble, 1992 cited in Ahmed & Dinye, 2015, p. 216).

Furthermore, development control encompasses core aesthetics, access, convenience, and safety principles. The implementation of control and order in the built environment is the only way to guarantee sustainable development because building control is geared toward ensuring the health and safety of building users and facilitating sustainable development (Ojelabi, Oyeyipo, & Afolabi, 2017). Conversely, the ineffective execution of development control legislations causes human settlements to suffer from illegal development with encroachment on public spaces thereby disrupting public spaces (Olufemi, & Ambrose, 2018; Peters, 2015), thus the need for obtaining planning approval (permit) by the prospective developers cannot be overemphasized. The planning approval process in Nigeria is not without challenges. And of concern and worrisome in southwestern Nigeria especially in Lagos State is the spate of illegal developments and building collapses being experienced. Several studies have explored compliance with planning laws and regulations while the issues of awareness, satisfaction, and willingness to participate in the planning approval process remain unresolved.

2. Conceptual Clarifications and Literature Review

2.1 Concept of Planning Approval Process

The planning approval (development permit) process is one of the instruments of development control (Ahmed & Dinye, 2011; Yaakup, Johar, Sulaiman, & Che Ngah, 2014; Odekunle, Akindele & Adebayo, 2019). Salau and Ogunleye (2015) define planning approval as a process through which the Planning Permit Authority secures the conformity of the proposals or applications with the Physical Development Plans. The planning approval process (PAP) is crucial to development control because it places responsibilities on the actors involved in the development control process. Both the planning agencies and prospective developers have a role to play. While the planning agencies will focus on implementing the planning law and regulations by ensuring that the development executed is within the provisions of the planning law and regulations, the prospective developer is expected to seek the permission of the planning agencies before embarking on the implementation of proposed plan (Ahmed & Dinye, 2011; Salau & Ogunleye, 2015).

The Nigerian Urban and Regional Planning Decree No 88 of 1992 as amended in Decree No 18 of 1999, which subsequently became a Law of the Federal Republic of Nigeria CAP 138 (LFN 2004) define what a development permit (planning approval) means. In Section 91 of the Act, "development permit" is interpreted to mean "permission to develop any land or buildings granted by the authority empowered to give such permission under this Act." Beyond the definition, various issues regarding planning approval are adequately provided for in the Nigerian Urban and Regional Planning Act 2004. Despite the laudable provisions of the Act and its potential for the built environment, only three out of the 36 states in Nigeria have been able to domesticate the Act (Akingboye, 2021).

The PAP is fraught with challenges worldwide, particularly the developing countries (Obateru, 2005). This assertion has been established by studies in Sri Lanka (Dissanayake, 1987), Ghana (Hammah, 2015), Malaysia (Yaakup, Johar, Sulaiman, & Che Ngah, 2014), and Nigeria (Agbola & Alabi, 2010; Salau & Ogunleye, 2015; Odekunle et al., 2019). For instance, in Nigeria, some of the challenges identified are political interference, bureaucracy bottleneck, and corruption by the practitioners (Agbola & Alabi, 2010; Ojelabi et al., 2017; Salau & Ogunleye, 2015). The identified challenges have also been aggravated by post-approval scenarios of the disregard for the approved plans and drawings (Windapo & Rotimi, 2012), and disregard for building regulations (Ojelabi et al., 2017). Some of these problems have implications for the real estate sector in form of the development of illegal structures, loss of time, cost overran, and project abandonment (Salau & Ogunleye, 2015).

2.2 Literature Review

Studies conducted in different contexts exploring development control and specifically planning approval are replete in literature. Dissanayake (1987) reported the ineffectiveness of development permit systems in Colombo (Sri Lanka) and posited that developers seek planning permission for the sake of having access to essential services (water and sewerage connections) but do not fulfil the requirement of the law. And as soon as developers obtain access to these services, conforming to the regulations is no longer their business as they get involved in the construction of unauthorized extensions and alterations, and changes of use of

buildings in the city. He also found out that some developers tried to evade the planning permit by buying a property with essential services, which they consider an easy route to obtain permits. Those who cannot afford essential services and meet up with the requirements of the law, do not bother about the development permit. Lastly, there was a lack of awareness about the existence of a development permit system, despite the literacy rate of Colombo residents being as high as 94%.

A study in Ibadan (Nigeria) reported that only 10.0% have approved building plans in Mapo (a neighbourhood within the core of the metropolis) while 41.3% of houses have approved plans in Apete (a residential neighbourhood in the peri-urban interface of the metropolis) (Adeniji & Ogundiji, 2009 cited in Agbola & Alabi, 2010). Obabori et al. (2007) in their study conducted in Ekpoma, Nigeria discovered that of the total 1,879 buildings that were registered for building plan approval, 1722 (91.6%) were approved by the Local Planning Authority while only 157 (8.4%) were unapproved. A study by Ogundele et al. (2011) that examined the challenges and prospects of physical development control in Festac town Lagos revealed that residents illegally convert residential buildings into mixed-use with the rate of contravention put at 48% among the residents. This was believed to have been aided by the Federal Housing Authority (FHA) officials who get involved in bribery and corruption. This further explained the low rating of FHA performance regarding development control where 22% of the residents rated their performance as good, 65% said fair and the remaining 13% stated poor.

In another study in some capital cities in southwestern Nigeria, it was found that Ibadan residents neither agree with the roles of development control agencies nor were satisfied with the activities engaged in by development control agencies. But the result from Osogbo and Ado-Ekiti indicated the level of agreement and satisfaction with development control activities was higher and highest respectively (Olowoporoku, Daramola, Agbonta & Ogunleye, 2017). Odekunle et al. (2019) sought residents' perceptions regarding development control practices in Abeokuta and findings showed that 91.8% of the residents thought that obtaining a development permit (planning approval) was too expensive, the primary reason for building without a development permit. The results imply that residents belonging to medium and high socioeconomic status find it convenient to apply for a development permit (planning approval). Residents with development permits also expressed their level of satisfaction with the development permit process revealing that 58.7% were dissatisfied whereas 41.6% expressed satisfaction.

Ahmed and Dinye (2011) examined the enforcement of development control in Wa Township in Ghana. Citing the Town and Country Planning Department in Wa, the total number of permit applications received is less than 10% of the developments each year. The non-acquisition of permits was adduced to the length of processing and ignorance. The developers who have building permits also expressed their frustration about the length of time required to acquire a permit, which thus confirms the reason why some developers do not have permits. Another study in Ghana sought to understand the reasons for the increasing amorphous planning and unapproved development/construction and identify the various planning approval problems. The findings indicated that "applicants must adhere to a series of unnecessary steps that influence the approval workflow process" as well as "the planning application workflow is unstructured and inconsistent, as individual workflow team members dealt with applications in a different manner." The study also revealed that the complexity of the planning approval process has considerable effects on the processing period (Hammah, 2015).

Salau and Ogunleye (2015) analyzed the challenges of development control in Lagos State, southwest Nigeria with a focus on the planning permit process as laid out in the Lagos State Urban and Regional Planning and Development Law of 2010 amongst others. They proffered strategies for achieving efficient processing of planning permit applications based on some challenges faced by the process in Lagos. The strategies include the decision to grant or refuse a planning permit should be with the consideration of public interest; the development of low order plans that would be specific about what should be where; the appropriate communication between physical planning agencies and property developers at every stage of planning approval process; the incorporation of ICT into planning permit process for effective communication; and the systematic approach to the incorporation of ICT as a new element into urban and regional planning. Other strategies put forward comprise the need to view physical planning as a means to promoting common good rather than revenue-generating means; transparency in the planning permit process such that the process is open and seen to always follow a logical process; the setting of a definite time frame in which the decision to approve or disapprove is taken; and retraining of staff when introducing new regulations, methods or tools; and the provision of adequate functional equipment (vehicles, archiving facilities, base maps, etc.) to enhance productivity and efficiency.

Ojelabi et al. (2017) assessed the building control measure in Lagos State and found that the processing and scrutinizing of buildings plans for approval is the measure ranked highest among the measures observed for the enforcement of building control, thus implying most building plans got approval before the commencement of construction. Findings also revealed that corruption and bureaucratic process strongly affects building control practices. The hypothesis test results indicated no significant difference among the group of professionals' perceptions of building control measures. Olufemi and Ambrose (2018) explored development control regulation compliance in Ado-Ekiti, Nigeria and the results revealed massive encroachment of public space mainly by informal commercial activities. It was also established that the disruption of public spaces is caused by the ignorance of good a quality environment, lack of effective governmental control, and people's desire for economic benefits. For instance, the study also indicated that 72% of the residents are aware of physical planning laws and regulations regarding the obtainment of planning permits before any development. While 47.9% of the houses obtained planning permission, 52.1% did not. The latter comprises 21.2% that never had a development permit and 30.9% that were unaware of the need to acquire a development permit.

A study by Omollo (2019) probed the effectiveness of development control in the monitoring of building development in Kisii town, Kenya to establish the extent to which the Building Code was enforced and findings indicated that 39% of the developers were ignorant of the need for the inspection of their development during construction. It was also predicted that awareness of building inspection was possible if the developers had issued inspection notices to the planning authority while those without planning permission were not likely to issue inspection notices. Onaiwu (2020) examined public compliance with development regulations in a Nigerian city and findings revealed poor compliance with development control regulations regardless of awareness by the developers, particularly about building coverage. Another study assessed compliance with development regulations and discovered that about 80% of the residents were aware that building without permission attracts penalties, about 70% did not obtain a development permit, about half of 31.5% who obtained a permit did not comply with the approved building plan, and about 60% were dissatisfied with the development permit process (Odekunle, Adebayo, Onabanjo & Sekoni, 2022). In a study conducted in Kisii town (Kenya) exploring the extent to which planning standards regulate setbacks of domestic (residential) buildings are complied with by developers, findings showed that most developments flouted planning standards regarding setbacks, a result attributed to a lack of development control by the County government (Omollo, 2019).

Though several studies have focused on development control in developing countries including Nigeria, the problems associated with the planning approval process have remained unresolved. This study would seek to evaluate the property developers' experience regarding the PAP in southwestern Nigeria. To achieve the study aim, the following questions would be asked. What is the state of awareness of property developers regarding the PAP? Are the property developers satisfied with the PAP? Are the property developers willing to participate in PAP discourse? And what are the current problems associated with the PAP? It is assumed that answers to these questions would assist to chart a new course for the PAP in Nigerian cities and those of developing countries with similar problems. However, the issues of awareness and satisfaction are of importance to this study for some reasons. Arimah and Adeagbo (2000) posit that awareness determines to a great extent the compliance with planning regulations. In their study, they found that awareness decreases successively from the high to the low-quality residential neighbourhood. More importantly, in the remark of Vagale (1970) cited in Arimah and Adeagbo (2000), "An enlightened and informed citizenry, a public spirited community and a sagacious political leadership are prerequisite to the success of development control." On the other hand, the understanding of the developers' satisfaction with PAP will assist the planning agencies to gauge their performance regarding PAP for them to ascertain aspects of PAP requiring improvement.

This study will contribute to the literature since most previous studies focused on public perception of development control especially compliance with planning standards though few examined challenges of PAP. There is also a dearth of studies that addressed satisfaction with PAP and willingness to participate in planning approval discourse. However, this study will help fill these gaps by drawing from the experiences of property developers who are important stakeholders in the development control sector and ultimately contribute to the existing body of knowledge. Additionally, the evidence as it will be revealed by this study will provide a Nigerian perspective, which may vary from other developing economies.

3. Methodology

3.1 Study Area

Nigeria is the most populous black nation in the world with a population of about 200 million. The country is made up of 36 states and a federal capital territory, which are further divided into 774 local government areas. Geographically, the nation lies between latitudes 4°E and 14°E and longitudes 2°N and 15°N. Nigeria covers a total area of 923,768km^2, which thus makes it the 32nd largest country in the world (Badejo, 2014). It is bounded by the Republic of Niger to the north, the Atlantic Ocean to the south, the Republic of Benin to the west, and Cameroon to the east. The country is the largest economy in Africa and its urbanization rate is unprecedented and considered one of the fastest and highest in the world (Oyesiku, 1998, 2010). The implication of urbanization
as occasioned by rapid population growth is the urban sprawl and lateral expansion of existing cities without articulate strategies to provide basic infrastructure (Oyesiku, 2010). To achieve sustainable development in the country, one of the viable measures is to control development in cities.

This study was conducted in three states of southwestern Nigeria comprising Lagos, Ogun, and Oyo. The southwest geopolitical zone is made up of six states that include Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo (Figure 1). The choice of the states was based on the fact that they are the only states in southwest Nigeria and in the whole of Nigeria that have domesticated the Nigerian Urban and Regional Planning Act 2004 (Akingboye**,** 2021). The southwest region is dominated by the Yorubas, one of the major ethnic groups in Nigeria.

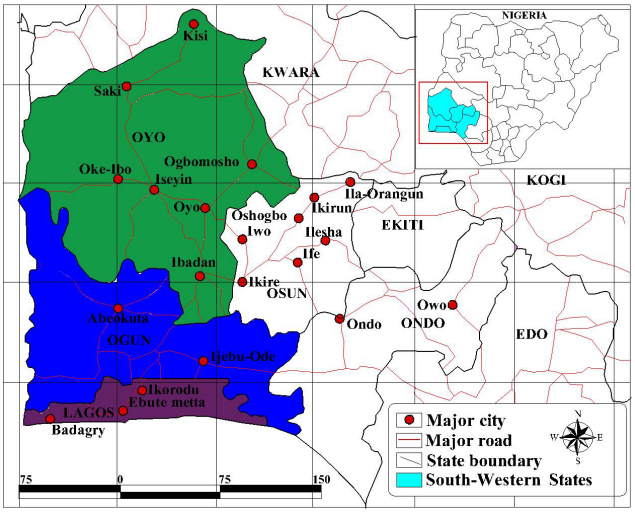

Figure 1 Map of the Study Area
Source: Ande et al. (2017)

3.2 Target Population

The target population for this study is the property developers who sought and were directly involved in seeking planning permits from the relevant government agencies saddled with development control in the study areas. This study recognized that not all property developers have direct contact with the planning agencies while seeking planning permits for their proposed developments. In other words, some developers employed representatives who are either town planners or other built environment professionals who helped in the processing of the planning permit.

3.3 Research Design, Survey Instrument, And Sampling Procedure

This study adopted a cross-sectional research design. Specifically, data were collected from the respondents at a single point in time. A structured questionnaire was used to elicit information regarding property developers' experiences with PAP. The questionnaire was mainly open-ended to allow respondents to express themselves without restrictions. Purposive and convenience sampling techniques were used in the selection of property developers. The purposive sampling technique was deployed since the property developers who had direct contact with the planning agencies constitute the target population. In other words, those who obtained planning permission through representatives were not qualified for participation as they would be unable to share such valuable information as required in this study. It is noteworthy that property developers' consent was sought and were assured that the information provided would serve academic purposes only. Subsequently, the convenience sampling technique is found suitable to elicit data from all property developers willing to participate in the study. The period of data collection spans between 28 October and 12 November 2021. Of the 130 property developers identified and consented to participate in this study, only 96 responded well to the questions posed and they constitute the sample size (Table 1).

Table 1 Questionnaire administration

State	Questionnaire distributed	Questionnaire retrieved
Lagos	58	45
Ogun	35	29
Oyo	37	22
Total	*130*	*96*

3.4 Data Analysis And Presentation

The qualitative data obtained from the property developers were collated, coded, and later transformed into quantitative data to be able to conduct quantitative analysis. In order words, thematic analysis was conducted by paying attention to the pattern of meaning in a dataset before categorizing them based on themes. Data obtained were analyzed descriptively. Further, inferential analyses (Chi-Square [χ^2] Tests and Spearman Correlation Test [r]) were conducted to test formulated hypotheses. Statistical packages used include SPSS version 25 and Microsoft Excel 2019.

3.5 Hypotheses Testing

For this study, four hypotheses were formulated and tested. The hypotheses are stated as follows:

i. H_0: There is no significant relationship between property developers' sociodemographic characteristics and developers' awareness of the legality of the planning approval process
ii. H_0: There is no significant relationship between property developers' sociodemographic characteristics and developers' willingness to participate in public hearings addressing the planning approval process
iii. H_0: There is no significant relationship between property developers' satisfaction with the planning approval process and their support for seeking planning approval
iv. H_0: There is no significant relationship between property developers' satisfaction with the planning approval process and the planning approval processing time

4. Results And Discussion

4.1 Sociodemographic Characteristics Of Property Developers

The results from Table 2 showed that of the 96 property developers interviewed, 71 (74%) were male while 25 (26%) were female. The minimum and maximum ages of developers were 26 and 86 years respectively, while the mean age was 49 years. Results also showed that the property developers are literate, a factor that may influence income, awareness, and their attitude toward the PAP. The employment status indicated that 87 (90.6%) of the respondents were gainfully employed, 4 (4.2%) were unemployed, and 5 (5.2%) were retirees. The analysis of the monthly income revealed that the majority of the developers fall within the medium- and high socioeconomic status, with a significant proportion of 60 (60.5%) earning above ₦90,000. The developers' income may have aided developers' ability to acquire or get involved in real estate development.

Table 2 Sociodemographic characteristics of property developers

Variables	Frequency	Percent
Gender		
Male	71	74.0
Female	25	26.0
Total	*96*	*100.0*
Educational level		
Primary	3	3.1
Secondary	6	6.3
Tertiary	84	87.5
No response	3	3.1
Total	*96*	*100.0*
Employment status		
Employed	87	90.6
Unemployed	4	4.2
Retired	5	5.2
Total	*96*	*100.0*

Monthly income		
Below ₦30,000	6	6.3
₦30,001-₦60,000	7	7.3
₦60,001-₦90,000	7	7.3
₦90,001-₦120,000	16	16.7
Above ₦120,000	42	43.8
No response	18	18.8
Total	*96*	*100.0*

4.2 Property Developers' Awareness of Planning Approval Process

4.2.1 Awareness of the legality of the PAP

This study also examines developers' awareness of the legality of the PAP. 66 (68.8%) of the respondents stated they were aware, 16 (16.7%) stated they were unaware and 11 (14.6%) did not respond (Figure 2). Olufemi and Ambrose's (2018) study in Ado-Ekiti (Nigeria) reported greater percentage (72%) of residents were aware of planning laws and regulations. The result from this study indicates the need to improve awareness of PAP to the extent that developers are aware of the roles of both the developers and planning agencies within the ambit of the extant planning laws in the various states.

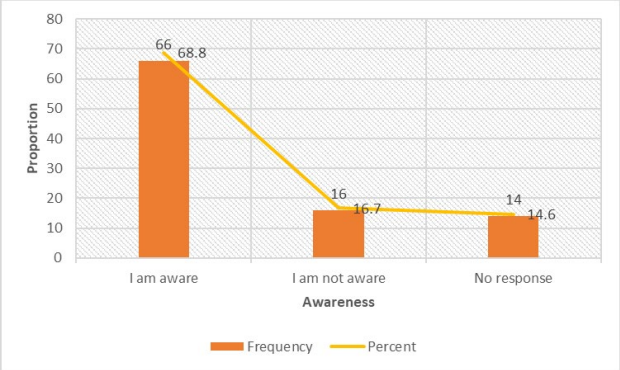

Figure 2 Awareness of the legality of the PAP

4.2.2 Date Of Awareness

Results from Figure 3 indicated that PAP has been around for over 4 decades in the study areas. The results from the analysis indicated an upward trend in awareness of the PAP between 1971 and 2020, which indicates good progress toward sustainable development in the study areas. Despite an encouraging trend in awareness as shown by the results, experience in the field indicated illegal developments still feature in towns and cities of the study areas. This corroborated Arimah and Adeagbo (2000) who posited that awareness is not a guarantee of compliance with planning laws and regulations, but it is a place to start with at least, as more still needs to be done by the planning agencies in the area of enforcement of the planning laws and regulations.

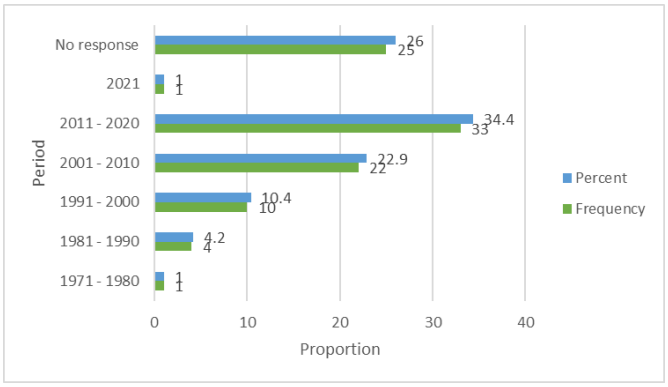

Figure 3 Date of awareness

4.2.3 Planning Agency Visited For Planning Approval

A larger percentage of the developers visited the appropriate planning agencies to obtain planning permits. However, few developers could still not differentiate between planning agencies from private planning firms, Land Bureau, and Environmental Protection Agency. It can also be deduced from the information gathered that Building Control Agency was also misconstrued for Planning Permit Authority, which applies to the developers in Lagos. Therefore, results suggest an attempt by the developers to obtain planning approval from unauthorized planning agencies so far as their developmental objectives are achieved, or perhaps a lack of awareness of the authorized planning agencies. Previous studies (Ahmed & Dinye, 2011; Olufemi & Ambrose, 2018) identified ignorance as the bane of development control.

4.2.4 Support for planning approval before development

Developers' perceptions regarding their support for seeking planning approval before development were obtained by this study. As shown in Figure 4, 86.5% of the developers declared their support for mandatory planning approval before development while 8.3% were not in support. This implies that the majority are aware of the importance of obtaining planning approval from the authorized agency before the implementation of their proposals. This set of developers could be partnered with by the planning agencies to disseminate information about PAP to the prospective developers.

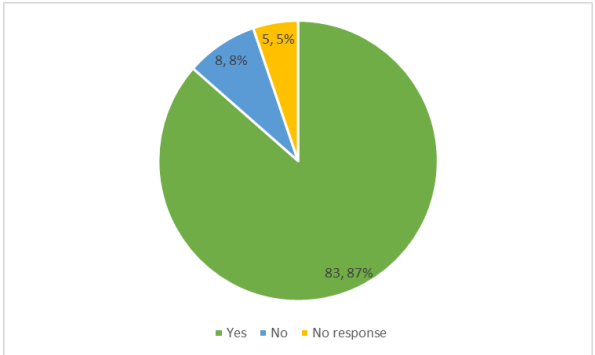

Figure 4 Support for planning approval before development

4.3 Developer's Satisfaction with Planning Approval Process

An attempt was made to determine respondents' satisfaction levels concerning the PAP and results showed that the majority (68 [70.8%]) were satisfied with the PAP whereas (20 [20.8%]) were dissatisfied (Figure 5). The satisfaction derived by the majority may be connected to the fact that a larger percentage of the developers obtain planning approval for their proposed development. This result is in contrast to the findings of Odekunle et al. (2019) where only 41.6% expressed satisfaction with the process.

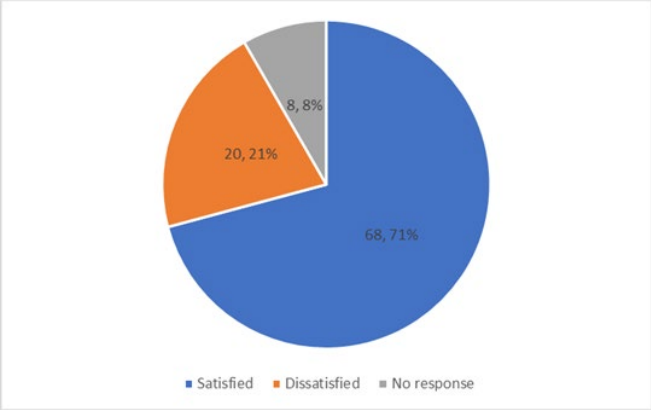

Figure 5 Satisfaction with the planning approval process

4.4 Property Developers' Willingness to Participate in Planning Approval Process Discourse

Figure 6 shows that 78.1% of the developers were willing to participate in public hearings addressing the issues of planning approval while 10.4% were unwilling to participate. The results indicated that there are a proportion of developers that needed to be enlightened on the importance of PAP to development control. The planning agencies can leverage the developers' willingness to get involved in planning approval for a participatory approach to planning. This step will negate the public perception that planning is "the exclusive preserve of small group of skilled professionals and bureaucratic elite as it is seen as a specialist and technical activity (Simon, 1992 cited in Arimah and Adeagbo, 2000).

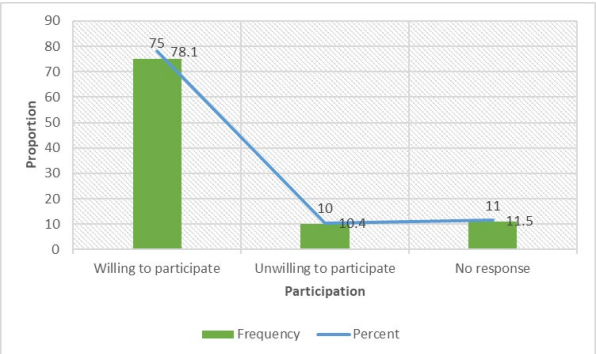

Figure 6 Willingness to participate in planning approval process discourse

4.5 Challenges of the Planning Approval Process

4.5.1 Processing Time Of Planning Approval

According to the Nigerian Urban and Regional Planning Act 2004, Section 34 (4) provides that "a Control Department may delay the approval of an application for development permission for a period of time not exceeding 3 months". With over half of the developers obtaining approval within the 3 months (Figure 7), a fairly good return time by the planning agencies can be deduced. However, information gathered from the planning agencies in Ogun and Lagos States indicates that planning approval can be obtained in 7 working days and 10 working days, respectively, which are shorter times compared to the provisions of the planning law in Nigeria. The short processing period currently being implemented is a welcome development, and this undoubtedly would encourage property developers who desire to obtain planning approval in the shortest possible time before the commencement of the proposed development. The effects of prolonged processing time of planning approval in Ghana as reported by Ahmed and Dinye (2011) and (Hammah, 2015) should be avoided for an improved PAP in the study areas.

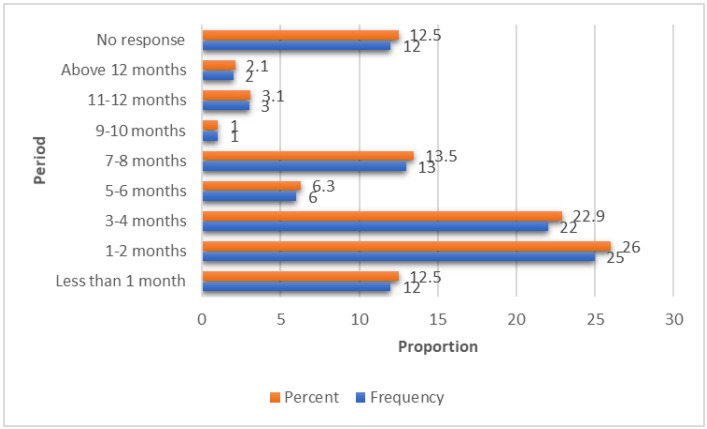

Figure 7 Processing time of planning approval

4.5.2 Assessment Fee For Planning Approval

The developers stated they paid assessment fees and other levies that range from ₦15,000 to ₦1,900,000 ($36.15 to $4,578.31). The variations are not far-fetched since developers obtained planning approval at different times, in different localities, and even for varying land-use types of development. Experience has shown that the assessment fee varies even within the same state. For instance, in Ogun State, the rate of the fees charged within urban centres is quite different from the rural areas. Similarly, Lagos State charges the highest rate of ₦64 per cubic metre for government schemes and ₦40 for other areas. It is noteworthy that some of the developers interviewed had obtained planning approval as far back as four decades ago, and this must have informed the low processing fee reported. The variations in the processing fees could also be linked to the review of the assessment fee from time to time (Olaseni, 2009). Olaseni (2009)

noted that "certain changes become inevitable and in the context of physical development, the law of demand and supply impose them as unavoidable burdens". Currently (as of 2021 when the study was conducted), there was no way for developers would pay as low as ₦15,000 ($36.15) in any of Lagos, Ogun or Oyo States. According to Olaseni (2009), Lagos, Ogun, and Oyo States were among the quartet in Nigeria that charged high processing fees for planning approvals. This high cost of assessment fees, Odekunle et al. (2019) noted was the main reason for development without planning approvals.

4.5.3 Documents Submitted To Planning Agencies

Table 3 presents documents required by the planning agencies for the processing of the planning approval in the study area. The majority (24.7%) of the developers stated architectural drawings, and next in order of importance include survey plan (23.6%), title document (15.3%), tax clearance certificate (12.8%), and structural drawings (10.8%). The other relevant documents requested for PAP include passport photographs (3.1%), Land Use Analysis Report (1.4%), Environmental Impact Analysis Report (1.0%), and Soil Test Report (0.7%). The marginal proportions recorded can be explained by the introduction of some of these requirements in recent years and the fact that they are requested for special cases, which depend on the type and magnitude of the proposed development. The remaining 6.6% of the developers stated mechanical and electrical drawings, site photographs, satellite imagery, processing fee receipt, and development levy. This deluge of documents required by the planning agencies is argued to contribute to the high cost of processing planning approval (Odekunle et al., 2019; Salau & Ogunleye, 2015). Hammah (2015) posited that these requirements hamper the free flow of PAP.

Table 3 Documents required for the planning approval process

Requirement	Frequency	Percent
Architectural drawing	71	24.7
Structural drawing	31	10.8
Survey Plan	68	23.6
Title Documents	44	15.3
Tax Clearance Certificate	37	12.8
Land Use Planning Analysis Report	4	1.4
Soil Test Report	2	0.7
Environmental Impact Analysis Report	3	1.0
Passport Photograph	9	3.1
Other documents	19	6.6
Total	**288***	**100.0**

*Total exceeded the number of a questionnaire administered due to respondents' multiple responses

4.5.4 Cases Of And Reason For The Rejection

Not all the developers have their applications approved by the planning agencies as the results from the analysis indicated that one-quarter (24) of the developers could not obtain planning approval. The reasons for the rejection are non-compliance with the planning standards (12.5%), the proposed site falling within government acquisition (2.1%), and the inability to submit required documents (2.1%). However, 8.3% of the developers could not specify what led to the rejection of their applications (Figure 8). This finding corroborates Obabori et al.'s (2007) study in Ekpoma which showed that 91.6% of the submitted applications were approved by the Local Planning Authority. The approval rate recorded in this study is still significant despite about 25% being denied planning approval due to the inability of the developers to meet certain requirements of the planning agencies. The results also indicate planning agencies displayed some degree of firmness in the implementation of planning law within their jurisdictions.

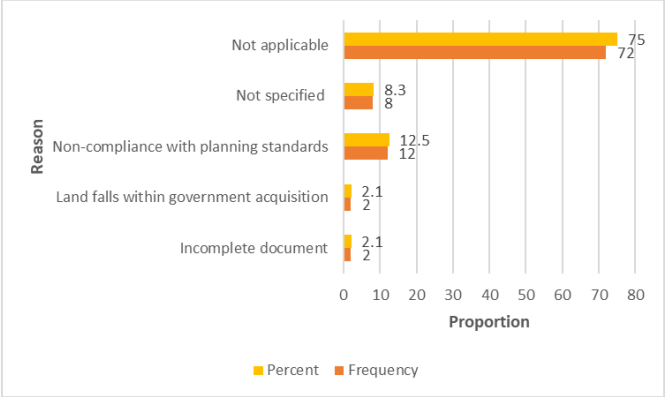

Figure 8 Cases of and reason for the rejection

4.5.5 Problems Of The Planning Approval Process

This study captures data regarding PAP and the analysis presented in Table 4 revealed that a majority (43 [38.1%]) of the developers described the PAP in southwestern Nigeria as time-consuming, thus implying delay in approval is a major problem with the process. Other problems with considerable proportion are bribery and corruption, stress for developers as well as high cost of processing fees. Corruption has been identified by previous studies (Agbola & Alabi, 2010; Ogundele et al., 2011; Salau & Ogunleye, 2015) to be one of the problems of PAP, and was affirmed to have significant effects on control practices (Ojelabi et al., 2017). Studies (Odekunle et al., 2019; Salau & Ogunleye, 2015) have also established the high cost of processing fees to be a major problem of PAP. Despite the problems perceived by some of the developers about the PAP, 23% opined that the PAP was without challenges.

Table 4 Problems of the planning approval process

Challenges	Frequency	Percent
Time-Consuming	43	38.1
Bribery and Corruption	14	12.4
High cost of the processing fee	6	5.3
Bureaucracy	5	4.4
Difficulty in processing documents	3	2.7
Change in government	1	0.9
Non-versatility of officials	3	2.7
Incoordination among agencies saddled with development control	2	1.8
No visible challenge	26	23.0
Stressful	8	7.1
Transportation	2	1.8
Total	**113***	**100.0**

*Total exceeded the number of a questionnaire administered due to respondents' multiple responses

4.6 Results of Hypothesis Testing

This study conducted further investigations by testing the formulated hypotheses. Hypotheses I and II were subjected to the Chi-Square test (Fisher's Exact Test) while hypotheses III and IV were subjected to Spearman Correlation Test.

4.6.1 Hypothesis Test I

H_0: There is no significant relationship between property developers' sociodemographic characteristics and developers' awareness of the legality of the planning approval process

Table 5 presents the observed statistical relationship between the distribution of a categorical variable (property developers' socio-demographic characteristics) with the distribution in another independent group of variables (developers' awareness of the legality of the PAP) through the use of Chi-Square (χ^2) test (Fisher's Exact Test). The results of the Chi-Square (χ^2) Test (Table 4) showed that two (2) out of the five (5) independent groups of variables were statistically associated with the developers' awareness of planning law backing PAP at the $p < 0.05$. They are the location of developers ($p=0.025$) and gender ($p=0.023$) with the calculated significant values less than the table value of 0.05.

Based on this result two variables were statistically significant as the calculated p-value of the Chi-Square (χ^2) Test was less than the table value of 0.05 (Table 4), hence, the rejection of the null hypothesis (H_0) that there is no significant relationship between property developers' sociodemographic factors and developers' awareness of the legality of the planning approval process.

Table 5 Summary of cross-tabulation and Chi-Square Test of sociodemographic characteristics and developers' awareness of the legality of the planning approval process

Sociodemographic profile	Category	Awareness of the legality of the planning approval process			Fisher's Exact Test	
		I am aware	I am not aware	Total	Value	Sig.
Location of developer	Lagos	37	5	42	6.907	0.025
	Ogun	14	9	23		
	Oyo	15	2	17		
	Total	*66*	*16*	*82*		
Gender	Male	53	8	61		0.023
	Female	13	8	21		
	Total	*66*	*16*	*82*		
Level of education	Primary	0	1	1	3.354	0.247
	Secondary	4	1	5		
	Tertiary	59	14	73		
	Total	*63*	*16*	*79*		
Employment status	Employed	60	15	75	1.248	0.577
	Unemployed	4	0	4		
	Retired	2	1	3		
	Total	*66*	*16*	*82*		
Monthly income	Less than ₦30,000	5	1	6	0.992	1.000
	₦30,001-₦60,000	5	0	5		
	₦60,001-₦90,000	6	1	7		
	₦90,001-₦120,000	14	2	16		
	Above ₦120,000	30	6	36		
	Total	*60*	*10*	*70*		

4.6.2 Hypothesis Test II

H_0: There is no significant relationship between property developers' sociodemographic characteristics and developers' willingness to participate in public hearings addressing the planning approval process

Table 5 presents the observed statistical relationship between the distribution of a categorical variable (property developers' socio-demographic characteristics) with the distribution in another independent group of variables (willingness to participate in public hearing addressing PAP) through the use of the Chi-Square (χ^2) test (Fisher's Exact Test). The results of the Fisher's Exact Test (Table 5) showed that none of the independent group of variables was statistically associated with the developers' willingness to participate in public hearing addressing PAP at the $p < 0.05$. In other words, all the cases were not statistically significant as the calculated p-value of Fisher's Exact Test was greater than the table value of 0.05. Therefore, the acceptance of the null hypothesis (H_0) that states that there is no statistical relationship between property developers' sociodemographic characteristics and developers' willingness to participate in public hearings addressing PAP.

Table 5 Summary of cross-tabulation and Chi-Square Test of property developers' sociodemographic characteristics and their willingness to participate in public hearings regarding the planning approval process

Sociodemographic profile	Category	Willingness to participate in a public hearing regarding planning approval process			Fisher's Exact Test	
		Willing to participate	Not willing to participate	Total	Value	Sig.
Location of developer	Lagos	33	5	38	1.122	0.577
	Ogun	23	4	27		
	Oyo	19	1	20		
	Total	75	10	85		
Gender	Male	57	5	62		0.125
	Female	18	5	23		
	Total	75	10	85		
Level of education	Primary	3	0	3	0.360	1.000
	Secondary	5	0	5		
	Tertiary	65	10	75		
	Total	73	10	83		
Employment status	Employed	71	9	80	2.131	0.474
	Unemployed	2	1	3		
	Retired	2	0	2		
	Total	75	10	85		
Monthly income	Less than ₦30,000	6	0	6	2.080	0.669
	₦30,001-₦60,000	7	0	7		
	₦60,001-₦90,000	7	0	7		
	₦90,001-₦120,000	13	1	14		
	Above ₦120,000	31	6	37		
	Total	64	7	71		

4.6.3 Hypothesis Test III

H_0: There is no significant relationship between property developers' satisfaction with the planning approval process and their support for seeking planning approval

Table 6 Summary of Spearman Correlation Test between property developers' satisfaction with planning approval process and their support for seeking planning approval

	Support for seeking planning approval	
Developers' satisfaction with the planning approval process	Correlation Coefficient	.339**
	Sig. (2-tailed)	.001
	N	86

**. Correlation is significant at the 0.01 level (2-tailed).

The Spearman Correlation is 0.339 (Table 6) and this means that there is a weak correlation between property developers' satisfaction with PAP and their support for seeking planning approval. Since the p-value (0.001) is less than the 0.01 level of significance as presented in Table 6, hence, the rejection of the null hypothesis (H_0). This implies that there is a significant relationship between property developers' satisfaction with PAP and developers' support for seeking planning approval.

4.6.4 Hypothesis Test IV

H_0: There is no significant relationship between property developers' satisfaction with the planning approval process and the planning approval processing time

Table 7 Summary of Spearman Correlation Test between property developers' satisfaction with planning approval process and planning approval processing time

	Planning approval processing	
Developers' satisfaction with the planning approval process	Correlation Coefficient	.250*
	Sig. (2-tailed)	.026
	N	80

*. Correlation is significant at the 0.05 level (2-tailed).

From Table 7, the Spearman Correlation is 0.250 and this indicates that there is a weak correlation between developers' satisfaction with PAP and the planning approval processing time. Since the p-value (0.026) is less than the 0.05 level of significance as presented in Table 8, hence the rejection of the null hypothesis (H_0). This result implies that a significant relationship exists between property developers' satisfaction with PAP and the planning approval processing time.

5. Conclusion And Recommendations

This study explored property developers' experiences with PAP in southwestern Nigeria. This study established that a larger proportion of property developers were male, literate, gainfully employed as well as belonged to the medium- and high socioeconomic classes. Findings also indicated that 68.8% of the developers affirmed their awareness of the legality of the planning approval process while awareness of PAP dated back over 4 decades ago. Over half of the developers obtained planning approvals within three months as provided by the Nigerian Urban and Regional Planning Act 2004. Results also indicated that some developers were unable to differentiate between authorized planning agencies saddled with the issuance of planning approval and allied agencies while variations were reported in the assessment fees charged and paid by the developers for planning approval processing. It was found that non-compliance to planning standards was the main reason for the cases of rejection experienced by some developers. The majority of the developers were satisfied with PAP as well as declared support for mandatory planning approval before development. Developers also considered PAP as time-consuming and characterized by a delay in processing, the major problem of the process. 78.1% expressed willingness to participate in public hearings regarding PAP.

The Chi-Square test (Fisher's Exact Test) revealed that the location of developers and gender among the sociodemographic characteristics of the developers were statistically significant with developers' awareness of the legality of the PAP. Whereas statistical significance does not exist between the developers' sociodemographic characteristics and developers' willingness to participate in public hearings addressing PAP. Furthermore, the Pearson Correlation tests revealed there was a significant association between developers' satisfaction with PAP and their support for seeking planning approval as well as the processing period of PAP, respectively.

Given the study findings, the following recommendations are put forward.

i. There is a need for planning agencies to improve the processing time of the PAP. The initiative in Lagos and Ogun States is laudable by making it a matter of policy to reduce the planning approval processing time. However, this policy must be conscientiously executed while Oyo State must take a cue from Lagos and Ogun States.
ii. Planning agencies should continuously engage the public, particularly the property developers on the need to seek planning approval before embarking on any kind of development. This step will change the public perception regarding planning as an elitist discipline, thus assuring the developers as key stakeholders in the development control process.
iii. Planning agencies should do more as a facilitator of PAP by creating enabling environment for prospective developers. One aspect deserving attention is the review of the assessment fee such that it should be less burdensome for developers particularly those of low socioeconomic status. In doing so, prospective developers would be willing to approach the planning agencies for planning approval, thus translating into a sustainable built environment.

One major limitation of this study is the geographical coverage, which was restricted to three states in southwestern Nigeria. Though the reason for the choice of the three states was that they constitute to date the only states in Nigeria that have domesticated the Nigerian Urban and Regional Planning Act 2004, thus demonstrating the willingness to implement development control as expected. However, a study that is regional or nationwide in scope would be desirable for future studies. Another limitation is that few studies have examined PAP from the perspective of the officials of the planning agencies. It would be apt for future studies to engage the officials of the planning agencies as their views would offer more insights regarding the PAP, particularly the attitude of the developers toward the PAP and the problems that militate against the hitch-free execution of PAP.

This study will undoubtedly make contributions to literature and will further our understanding of the planning approval process in a developing country like Nigeria. Findings from this study will be useful for policy formulation particularly in the area of education as well as awareness creation among property developers about the importance of adherence to planning laws and regulations, expediting planning approval processing time, and ease of procuring documents required by the planning agencies. It will also help planning agencies to improve their services to the public, particularly property developers such that they will derive greater satisfaction from the planning agencies' services, and lastly inspire the public willingness to participate in planning matters that will bear on the PAP not only on the southwestern Nigeria but other geopolitical zones in the country. Finally, an improvement in the planning approval system in Nigeria can serve as a model to other developing economies with which it shares similar attributes.

Acknowledgement

I would like to thank the reviewers whose comments helped to improve this paper. I would also like to thank Oscar Osemete for helping with the map digitization and Mark Awolola who assisted with the data entry.

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IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 31-42

Covid-19 Pandemic and Its Effects on Social Life and Reflections on Spatial Preferences

Hilal Kahveci
Department of Interior Architecture and Environmental Design,Faculty of Fine Arts and Design, Bilecik Seyh Edebali University, Turkey

Makbulenur Onur
Department of Landscape Architecture, Karadeniz Technical University, Turkey

ABSTRACT

The Covid-19 pandemic, which emerged in Wuhan city of China's Hubei province in December 2019, affected the whole world in a short period of 3 months. The Covid-19 outbreak, which was declared a pandemic by the World Health Organization as of March 12, 2020; was imposed significant restrictions on the use of open spaces, which adversely affected the daily life of individuals physically, mentally and socially. Apart from the health problems experienced by people, it has also created many spatial choices and changes. New preferences, where social distance is at the forefront, have started new venue organizations along with new requests. Although the changes experienced with the Covid-19 pandemic may seem negative, they contain opportunities that allow change and development. Making people's living environments more functional, remembering the importance of nature and reviewing social relations can be evaluated in this context. Looking from history to the present, the Covid-19 pandemic is not the first and will not be the last. For this reason, the study aims to investigate the change in the spatial preferences in the society with the pandemic and to create an idea for the next pandemics. In this context, 289 people were reached by using the online survey method and various questions were asked. Various results were obtained and interpreted by performing variance analysis, factor analysis, correlation analysis, crosstabs test and frequency analysis ($P<0.01$) on the obtained data. As a result of the study, from the statistical data, it has been observed that 'people are more oriented to nature' due to the Covid-19 pandemic and that open green spaces suitable for social distance are sought in spatial preferences. These findings shed new light on the value of urban nature as resilience infrastructure during a time of crisis.

Article History

Received : *25 July 2022*
Received in revised form: *07 December 2022*
Accepted : *08 December 2022*
Published Online : *31 December 2022*

Keywords:

Environmental problems, human-nature relationship, landscape design in Covid19

Corresponding Author Contact:

mnurbekar@ktu.edu.tr

DOI: 10.11113/ijbes. v10.n1.1048

1. Introduction

In the historical process, people have started to create artificial environments by preferring to control and regulate their environment instead of accepting environmental conditions, these environments have affected the ecological cycle and the failure to maintain the environmental balance has caused environmental problems that endanger the lives of many living things, including humans (Erdogan 2006; Dinctürk et. al. 2020; Gulpinar Sekban, Acar 2021). Especially in cities, the increase in

interventions to nature and wildlife as a result of rapid population growth in cities has caused many disasters such as floods, earthquakes, global warming, climate change, etc. (Sharifi and Gamsir 2020). In addition, epidemics that occur with the increase in circulation and immigration around the world are another important negative phenomenon. Many epidemic diseases such as plague, leprosy, cholera, influenza, HIV / AIDS epidemic, Ebola virus have caused the death of many people in history and have led to permanent changes in the world (Ahmadi et al. 2020). Finally, the Covid-19 pandemic, which emerged in the city of Wuhan of China's Hubei Province in December 2019, has affected the whole world (Hu et. al. 2021; Shakibaei et. al. 2021; Megahed and Hassan, 2021). The new Coronavirus disease (Covid-19) is a virus defined by WHO on January 13, 2020, as a result of research conducted in a group of patients with respiratory symptoms (fever, cough, shortness of breath) (T.R. Ministry of Health). Globally, as of 4:38pm CEST, 5 May 2021, there have been 153.954.491 confirmed cases of Covid-19, including 3.221.052 deaths, reported to WHO (WHO, 2021). The coronavirus, which affected the whole world, has come up with new norms. In addition to the consequences of this pandemic on health, it is possible to affect the whole world with socio-cultural, political, economic and many unforeseen problems.

According to a 2012 report by ILRI, more than 2 million people die each year from diseases transmitted by pets and wild animals (URL 1). Budak and Korkmaz (2020) emphasize that we need to be aware of the forces of nature and that these epidemics may occur in the future, as they have happened in the past and present. With the vaccines and antibiotics found in the 1970s, many scientists misunderstood that the era of diseases was over, but over time, the diseases returned via structural changes. Since the 1970s alone, pathogens that cause more than one thousand five hundred new diseases, 70% of which are of animal origin, have emerged (Budak and Korkmaz 2020).

1.1. The Covid-19 Pandemic: Spread And Social Restrictions

An unusual period has started with the Covid-19 pandemic. In many parts of the world, concerns about the Covid-19 pandemic and quarantine policy have led to a general decline in the physical and mental health of residents due to insufficient social interaction (Shakibaei et. al. 2021). These adverse effects may have potential public health risks (Xie et al. 2020; Megahed and Ghoneim 2020; Lades et al. 2020; Robinson et. al. 2021). The Covid-19 pandemic might have a lasting impact on what we deal with in our built environment and open spaces. From its start, researchers and practitioners have felt the need to reflect on its consequences, which are spatial and social as well as political and economic (Gill et al. 2020). Although there are some statements about when and how this epidemic will end, there is no complete information on this issue. Countries trying to restrict the spread of the epidemic are changing the dynamics of the urban and rural environment by taking measures such as preventing outdoor use, imposing travel restrictions, quarantining their citizens, canceling large gatherings such as sports and concert events (Dinctürk et al. 2020). As of May 2020, Turkey put an end to the ordinary lifestyle and started a new understanding of life with the process of restrictions.

Each pandemic has had a tremendous negative impact on humans as pandemics are also a social phenomenon that affects the individual and society at many levels and causes deterioration. As the perception of threat by a contagious disease increases, people experiencing panic and stress exhibit different behaviors than usual. Especially during epidemics, people's longing for nature is increasing, and this situation causes various social problems (Mansuroglu 2021). When faced with a situation whose effects such as an epidemic cannot be predicted, people show protection and avoidance with a sense of fear and panic (Karatas 2020). Health care services have an essential role in addressing these emotional outbreaks as a part of the pandemic response. Education and training related to psychosocial problems should be supplied to health care professionals (Shakibaei et. al. 2021). The mental health and emergency management communities should work together to identify, develop, and disseminate evidence-based resources regarding mental health, mental health triage and referral, needs of special populations, and death notification and bereavement care (Pfefferbaum and North, 2020).

1.2 Landscape Architecture; Environmental Improvements And The Pandemic

Environmental conditions and human interventions to nature lie at the root of the health problems of all living things in the world. The coronavirus (Covid-19), which forces us to stay at home, upsets our social and kinship relations, changes our habits, and turns economies upside down, is also the result of environmental interference and intervention to nature (URL 2). It is an important and functional requirement for the professional group of landscape architecture to have a say in the correct nature-friendly land-use decisions, especially in landscape and ecological planning (Atıl et al., 2005). In this context, landscape architecture is among the most important professional disciplines that respond to the "open space" requirements that have emerged with the pandemic. People who have moved away from indoor spaces and even become afraid of them have found their escape points in “open spaces” (Onur, 2020). Landscape architecture contributes to health, productivity, and regeneration when decisions integrate with systemic order, promote interdependence, respond to context, integrate interdisciplinary knowledge (Motloch, 2001).

Covid 19 has already transformed our places through architecture, design, and urban planning (Megahed and Ghoneim 2020). Also with the pandemic, people have understood the importance of nature, and the idea of turning to nature for a healthy life by moving away from the stressful city life and the concrete urban texture has gained importance. The benefits of urban landscapes to people are not only aesthetic and natural beauties, but also provide place experience and belonging (Rodríguez Iturriaga 2021). In fact, in landscape architecture studies after 1990, the positive effects of the human-nature relationship on health were stated, and within the scope of this subject, the regulations such as rock gardens, green

walls, roof gardens, hobby gardens, green building movement began to take place. There's already increasing interest in biophilic design, the including of nature into the building, site, city. Biophilic design extinguishes or reduces anxiety in people, primarily through design with natural features. Against pandemics, researchers are investigating syntactic links between children and nature, the old people and nature. Engaging with nature even just visually boosts our positive feelings, influences mental health, so visual engagement may become more important (Beatley and Newman 2013; Crosbie 2020).

Despite the developments in technology and medical science, it has been seen that new epidemics cannot be prevented in the 21st century and people are still helpless in this regard. With all these written news and findings, all knowns have changed and "new wishes and needs" have taken their place. The epidemic continued with the measures introduced and people moved towards a simple life away from contact. This has forced people to their individual lives at home and then to natural environments. People who moved away from nature with urbanization have once again understood the importance of nature and their need for natural spaces. Undoubtedly, landscape architecture also has a role in this process with many positive/negative results. In this study, the venue preferences of people before the Covid-19 outbreak and the positive and negative activities involved in their lives during the Covid-19 were investigated. In addition, it is aimed to raise awareness about the importance of natural substances in people's space preferences and use.

2. Material and Method

Within the scope of this study, previous studies on the Covid-19 pandemic were primarily examined (Ahmedi et al. 2020; Budak and Korkmaz 2020; Crosbie 2020; Dinçtürk et. al. 2020; Lades et. al. 2020; Onur 2020; Megahed and Ghoneim 2020; Sharifi and Gamsir 2020; Venter et. al. 2020; P′erez-Urretarazu el. al. 2021;). As a result of the literature study, criteria were determined to help measure the spatial change before/after the Covid-19 outbreak. Then, the criteria were transformed into questions representing them in order to conduct an online survey. Tables (Table 1-10) containing the data obtained by transforming the criteria into questions are given. The method flow chart of the study is summarized in Figure 1.

All of the data acquired in the survey study were subjected to statistical evaluations similar in the studies of Cuevas et. al. (2004); Kalayci (2009); Acar et. al. (2014); Guneroglu (2017); Wooditch et. al. (2021); Robinson et. al. (2021) and findings and results have been obtained. After the answers given to the survey questions were transferred to the Excel 2016 program as raw data, they were processed with the SPSS program and turned into findings. During the study period, an online survey was conducted with 289 people. The tests carried out within the scope of the study and their objectives are given below;

- Variance Analysis: Variance Analysis (ANOVA) was used to check whether there is a significant difference according to the determined parameters.
- Factor Analysis: This test was used to turn the parameters into meaningful and independent factors.
- Correlation Test: A correlation test was used to determine if there is a relationship between criteria.
- Crosstabs: The Crosstab test was used to calculate whether the dependent variables are related to each other, that is, to calculate their statistical significance.
- Frequency Analysis: It was used to determine the usage preferences of individuals.

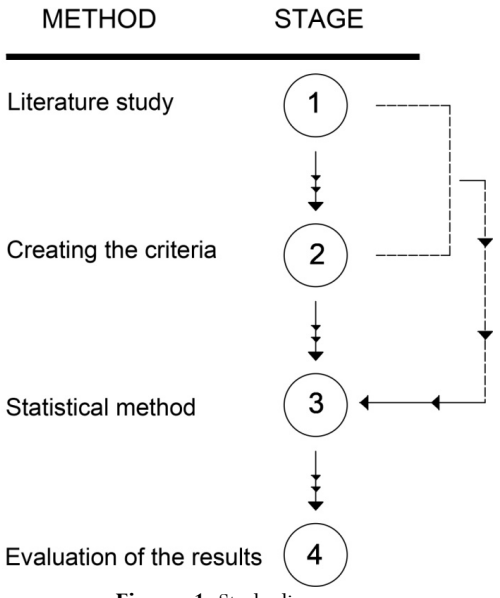

Figure 1. Study diagram.

3. Findings

In this study, it was investigated whether there was a change in the spatial preferences of people as a result of the restrictions and changes caused by the Covid-19 pandemic and 289 people were reached by an online survey method for this purpose. Spatial preferences and reasons before the Covid-19 pandemic outbreak and how the spatial preference was changed after the Covid-19 pandemic outbreak were investigated in the first part of the study. Space preference parameters were investigated in the second part. Opinions were asked about whether the design-based professional disciplines should change in the last part.

When the results of variance analysis (ANOVA) in order to check whether there is a significant difference between the answers given to the question "Which spatial did you prefer to go before the Covid-19 outbreak (Table 1)" and "Why did you prefer these spatial (Table 2)" were examined, it was determined that p (sig.) < 0.05, and it was determined that there is a significant difference between the criteria set (Table 1). It was concluded that people mostly preferred to go to cafes and restaurants before the pandemic outbreak, (5,18), and the reasons for preferring these places were firstly the scenery characteristic (4,12), then the presence of various activities for children (3,18), and the lack of parking problems (3.00) (Table 2).

Table 1. Variance analysis (ANOVA) for the spatial preferences before the Covid-19 outbreak.

					95% Confidence Interval for Mean	
Criteria	Mean Square	Sig.	Std. Deviation	N	Lower Bound	Upper Bound
Cafes and restaurants	**5,33**	,000	1,151	61	5,03	5,62
Open areas/recreational areas	5,18	,000	2,101	92	4,75	5,62
Non-urban (village/highland) natural fields	5,21	,000	1,008	34	4,85	5,56
Malls	3,56	,000	2,259	34	2,77	4,35
Town square and its surroundings	4,93	,000	2,052	15	3,80	6,07
Shores/coastlines	4,98	,000	1,248	53	4,64	5,33
Total	4,98	,000	1,773	289	4,77	5,18

Table 2. Variance analysis (ANOVA) for the spatial preference reasons before the Covid-19.

					95% Confidence Interval for Mean	
Criteria	Mean Square	Sig.	Std. Deviation	N	Lower Bound	Upper Bound
Lack of parking	3,00	,000	1,477	12	2,06	3,94
Closeness	2,82	,000	1,957	38	2,17	3,46
Cheapness	2,83	,000	2,137	6	0,59	5,08
Presence of activities for children	**3,18**	,000	1,557	38	2,67	3,70
Scenery	**4,12**	,000	1,990	42	3,50	4,74
Having open space	2,88	,000	1,785	101	2,53	3,23
No other alternatives	1,92	,000	1,557	52	1,49	2,36
Total	2,92	,000	1,862	289	2,71	3,14

Within the scope of the study, cross-table analyzes (Crosstabs Analysis) were carried out in order to measure which factors in the pandemic process affect people's psychological state. These analyzes are grouped under three headings: "*The effect of the gender factor on the state of being psychology affected* (Figure 2)", "*The effect of the spatial factor, where you spend most of the day during the pandemic, on the state of psychologically affected* (Figure 3)" and "*Investigation of the changing spatial preferences before/after the pandemic outbreak* (Table 3)".

- **The effect of the gender factor on the state of being psychologically affected:** In order to determine the effect of the gender factor on the psychologically affected state, the gender results were first investigated within their own categories, then in the combined category, and finally in the answers given for the "psychologically affected state". When the results were examined, 88% of the participants say that they are psychologically affected by the outdoor restrictions. 58% of these answers belong to women and 42% to men. In the cross tables according to gender, it can be concluded that the female population is more affected by this ratio (Table 3).

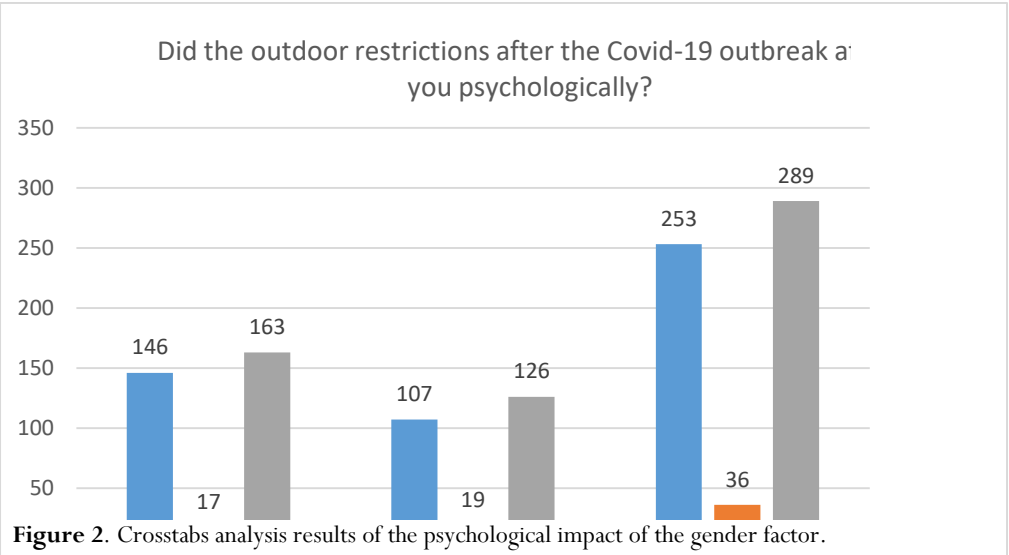

Figure 2. Crosstabs analysis results of the psychological impact of the gender factor.

- **The effect of the spatial factor, where most of the day was spent during the pandemic, on the state of being psychologically affected:** In order to determine the effect of the place factor, where most of the day was spent, on the psychologically affected state, the gender results were analyzed first within their own categories, then in the combined category, and finally within the answers given to the "psychologically affected state". From the results, it can be concluded that 88% of the participants say that they are psychologically affected by outdoor restrictions. From the group results that constitutes 88% of participants, the highest results: 44% are "people who spend most of their days in front of a computer", 20% are "people who spend their days in taking care of the house" and 13% are "people who "spend most of their days in front of a TV" (Table 4).

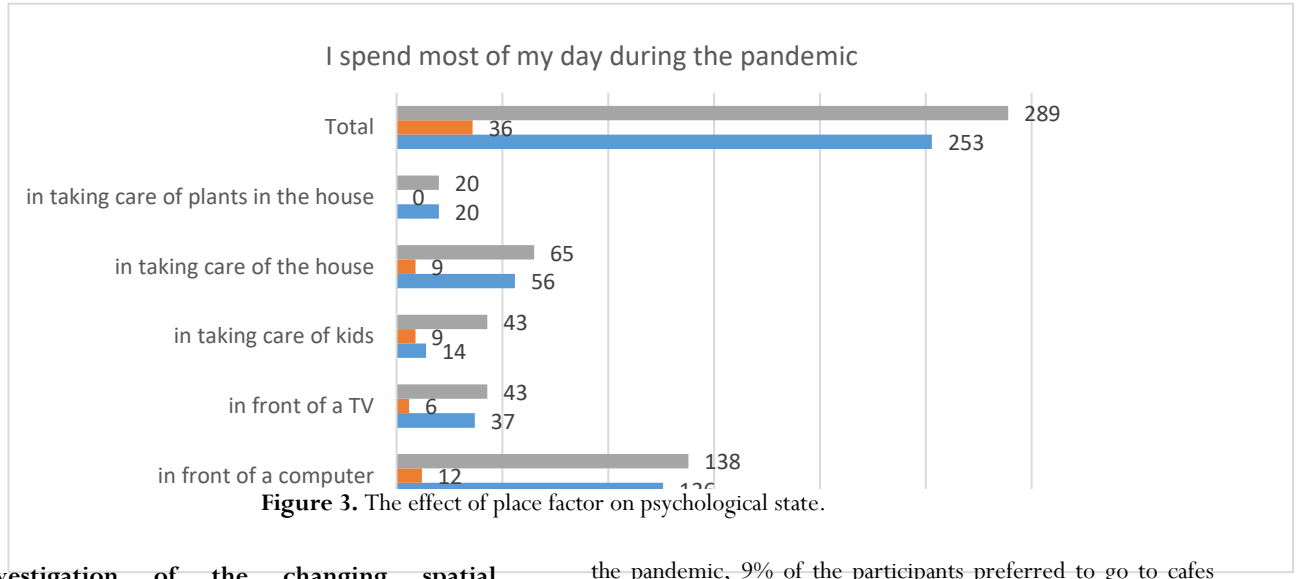

Figure 3. The effect of place factor on psychological state.

- **Investigation of the changing spatial preferences before/after the pandemic outbreak:** The same spatial parameters were considered for the spatial preferences "before and after" the pandemic outbreak. However, the preference rates have varied dramatically. While **23.7%** of people preferred to go to cafes and restaurants before the pandemic, 9% of the participants preferred to go to cafes and restaurants after the pandemic outbreak. Likewise, while 15.7% of the participants preferred to go to open spaces before the pandemic outbreak, 41.9% of the participants began to prefer open spaces after the pandemic outbreak (Table 3).

Table 3. Spatial preferences before/after the pandemic outbreak.

Which places did you prefer to go "BEFORE" the Covid-19 outbreak? Which places did you prefer to go "AFTER" the Covid-19 outbreak?				
	"BEFORE"		**"AFTER"**	
	Frequency	Percent	Frequency	Percent
Cafes and restaurants	**92**	23,7	**35**	9,0
Open areas/recreational areas	**61**	15,7	**163**	41,9
Non-urban (village/highland) natural fields	34	8,7	24	6,2
Malls	34	8,7	-	-
Town square and its surroundings	15	3,9	14	3,6
Shores/coastlines	**53**	13,6	**53**	13,6
Total	289	74,3	289	74,3

In another question of the study, the participants were asked what kind of changes they made in interior spaces during Covid-19. From the results, it is seen that the highest result was obtained from "I bought kitchen equipment to cook" with 36.2% and "I strengthened the technological infrastructure of communication and education" with 26.5% (Table 4).

Table 4. Changes in the interior spaces during the Covid-19.

What kind of changes did you make in the interior spaces during the period when you started to spend time indoors after the Covid-19 outbreak?				
	Frequency	Percent	Valid Percent	Cumulative Percent
I bought kitchen equipment for cooking	141	**36,2**	48,8	48,8
I strengthened the technological infrastructure for communication and education	103	**26,5**	35,6	84,4
I bought and started growing plants	35	9,0	12,1	96,5
I owned pets	10	2,6	3,5	100,0
Total	289	74,3	100,0	

Principal component analysis was performed to measure the changing behavior patterns at this stage of the assessment (Table 5). In order to obtain the findings of these criteria, 2 components, which constitute approximately 63% of the total data variances, were determined as a result of factor analysis in the data collection containing 6 criteria. Factor load and common variance values according to factor analysis results are given in Table 5.

As a result of the analysis, it was determined that the factor loads vary between 0.748 and -0.457, and the common variance ranges between 0.423 and 0.748. As seen in this analysis, the 1st-factor load has a higher load than the other factors. Therefore, in the determination of the changing preferences during the Covid-19, the factors "With Covid-19; I tended towards activities that I could enjoy nature (0,748), "I was more interested in my home (0,746)", I discovered different spatial to go in my city (0,650)" were found to be important (Table 5).

Table 5. Factor analysis of the criteria

Criteria	Factor load	
	1	2
With Covid-19; I spent more time with my child/children	0,423	0,722
With Covid-19; I became more interested in my home	**0,746**	0,347
With Covid-19; I moved away from indoor spaces	**0,564**	0,364
With Covid-19; I discovered different places to go in the city I live in	**0,650**	-0,457
With Covid-19; I found new hobbies	**0,727**	-0,291
With Covid-19; I turned to activities that I could enjoy nature	**0,748**	-0,349
% of variance	42,764	19,825

The correlation analysis was applied to the 6 criteria, for which factor analysis was performed in Table 7, at this stage of the study (Table 6). This analysis was performed in order to see whether there is a relationship between the criteria or not, and if there is a relationship, to see it exists between which types of behavior. The results show that the strongest relationship is among the criteria "I found new hobbies for myself during Covid-19 and "I turned to activities that I can enjoy nature"(0,493**). The next strong relationship is between the "With Covid-19; I moved away from indoor spaces" and "With Covid-19; I turned to activities that I could enjoy nature" (0,450**).

Table 6. Correlation data between the behavior criteria.

Correlation						
Correlation Coefficient	C1.	C2.	C3.	C4.	C5.	C6.
C1	1	0,431**	0,247**	0,075	0,068	
C2	**0,431****	1	0,380**	0,285**	0,404**	
C3	0,247**	0,380**	1	0,162**	0,311**	
C4	0,075	0,285**	0,162**	1	0,404**	
C5	0,068	0,404**	0,311**	**0,404****	1	
C6	0,060	0,280**	**0,450****	0,075	**0,493****	1
C1. With Covid-19; I spent more time with my child/children						
C2. With Covid-19; I became more interested in my home						
C3. With Covid-19; I moved away from indoor spaces						
C4. With Covid-19; I discovered different places to go in the city I live in						
C5. With Covid-19; I found new hobbies						
C6. With Covid-19; I turned to activities that I can enjoy nature						
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Principal component analysis was performed on the parameters by which spatial preference with Covid-19 was measured (Table 7). In order to obtain the findings of these criteria, 6 components, which constitute approximately 63% of the total data variances, were determined as a result of factor analysis of the data containing 18 criteria. The factor loads and common variance values obtained with the factor analysis are given in Table 9. The highest factor components accumulated under the first-factor load. According to the results, the highest factor components are as follows; "*Pandemic has taught me that I can be happy engaging with nature (0,725)*", "*My interest in nature increased during the pandemic (0,691)*", "*I understood the value of nature more during the pandemic (0,677)*", "*After the pandemic outbreak, spatial that give importance to ecological approaches started to attract my attention more (0,676)*" and "*With Covid-19; I tended towards activities that I could enjoy nature (0,620)*".

Table 7. Factor analysis of criteria

No	**Criteria**	**Factor loads**				
		1	**2**	**3**	**4**	**5**
1	With Covid-19; I tented towards activities that I could enjoy nature	0,620	-0,396	-0,059	0,131	0,096
2	With Covid-19; I started reading more books	0,466	-0,165	0,083	0,218	0,278
3	Before the Covid-19 outbreak, I preferred indoor spaces more	0,296	-0,045	0,748	0,065	-0,129
4	After the Covid-19 outbreak, I prefer open spaces more	0,596	-0,009	0,250	0,180	-0,239
5	Even if the pandemic is over, I will continue to go to more open areas	0,603	0,049	-0,354	0,088	0,089
6	My interest in nature has increased during the pandemic	0,691	-0,438	-0,166	0,089	-0,124
7	After the pandemic outbreak, my interest in open spaces increased	0,499	-0,025	0,039	0,182	-0,438
8	I understood the value of nature more during the pandemic	0,677	-0,167	-0,145	0,128	-,0194
9	The pandemic has taught me that I can be happy engaging with nature	0,725	-0,334	-0,201	-0,033	-0,028

10	I am aware that I am experiencing changes in my spatial preferences	0,654	0,111	0,351	-0,107	-0,045
11	Before the pandemic outbreak, my aesthetic concerns were more prominent in my spatial preferences	0,499	0,094	0,385	-0,346	-0,053
12	After the pandemic outbreak, spatial that give importance to ecological approaches started to attract my attention more	0,676	-0,183	-0,187	-0,440	0,145
13	I need natural elements to be included in the interior during the pandemic	0,465	0,093	0,029	-0,598	0,273
14	After the pandemic outbreak, I pay attention to the fact that the place I am in is large and suitable for social distance	0,571	0,587	-0,084	0,048	-0,101
15	After the pandemic outbreak, I give importance to the fact that a place I will go has a possibility of an open space	0,575	0,528	-0,201	-0,029	0,145
16	After the pandemic outbreak, I pay attention to the fact that the places I will go are spacious and hygienic	0,489	0,602	-0,108	0,169	-0,097
17	During the Covid-19, my city offered me enough opportunities	0,200	0,113	0,031	0,497	0,412
18	After the pandemic outbreak, I started doing sports outdoors/at home	0,269	-0,048	0,302	0,178	0,615

When we look at the relationships between Covid-19 and the parameters in which the spatial preference is measured, it is seen as in Table 8, that the strongest relationship (0,600**) is between the parameters "*My interest in nature increased during the pandemic*" and "*The pandemic has taught me that I can be happy engaging with nature*". Other strong relationships are between "*14th After the pandemic outbreak, I pay attention to the fact that the place I am in is large and suitable for social distance*" and "*15th After the pandemic outbreak, I give importance to the fact that a place I will go has a possibility of an open space* (0,575**)", and then between "*1th With Covid-19; I tented towards activities that I could enjoy nature*" and "*9th The pandemic has taught me that I can be happy engaging with nature* (0.568**)", and then between "*9th The pandemic has taught me that I can be happy engaging with nature" and "11th After the pandemic outbreak, spatials that give importance to ecological approaches started to attract my attention more* (.538**)".

Table 8. Correlation table according to the spatial preference

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	,360**	,172**	,275**	,279**	,568**	,245**	,363**	,568**	,272**	,244**	,413**	,166**	,209**	,188**	,184**	,117*	,197**
2	,360**	1	,165**	,274**	,253**	,323**	,117*	,231**	,262**	,290**	,104	,297**	,109	,182**	,208**	,170**	,058	,210**
3	,172**	,165**	1	,296**	-,011	,141*	,170**	,136*	,100	,306**	,259**	,086	,126*	,123*	,057	,058	,086	,117*
4	,275**	,274**	,296**	1	,338**	,382**	,289**	,383**	,346**	,453**	,239**	,265**	,164**	,326**	,246**	,229**	,070	,130*
5	,279**	,253**	-,011	,338**	1	,385**	,241**	,399**	,370**	,343**	,139*	,447**	,209**	,309**	,401**	,251**	,180**	,093
6	,568**	,323**	,141*	,382**	,385**	1	,399**	,528**	,600**	,309**	,234**	,470**	,233**	,196**	,233**	,121*	,116*	,093
7	,245**	,117*	,170**	,289**	,241**	,399**	1	,352**	,317**	,274**	,219**	,216**	,112	,257**	,214**	,258**	,032	,105
8	,363**	,231**	,136*	,383**	,399**	,528**	,352**	1	,576**	,356**	,242**	,380**	,234**	,309**	,226**	,303**	,131*	,122*
9	,568**	,262**	,100	,346**	,370**	,600**	,317**	,576**	1	,359**	,286**	,538**	,282**	,256**	,293**	,208**	,108	,153**
10	,272**	,290**	,306**	,453**	,343**	,309**	,274**	,356**	,359**	1	,445**	,387**	,270**	,378**	,325**	,255**	,081	,195**
11	,244**	,104	,259**	,239**	,139*	,234**	,219**	,242**	,286**	,445**	1	,349**	,294**	,202**	,228**	,271**	,089	,109
12	,413**	,297**	,086	,265**	,447**	,470**	,216**	,380**	,538**	,387**	,349**	1	,473**	,236**	,362**	,163**	,011	,095
13	,166**	,109	,126*	,164**	,209**	,233**	,112	,234**	,282**	,270**	,294**	,473**	1	,267**	,275**	,172**	,033	,162**
14	,209**	,182**	,123*	,326**	,309**	,196**	,257**	,309**	,256**	,378**	,202**	,236**	,267**	1	,575**	,544**	,071	,082
15	,188**	,208**	,057	,246**	,401**	,233**	,214**	,226**	,293**	,325**	,228**	,362**	,275**	,575**	1	,470**	,135*	,149*
16	,184**	,170**	,058	,229**	,251**	,121*	,258**	,303**	,208**	,255**	,271**	,163**	,172**	,544**	,470**	1	,169**	,048
17	,117*	,058	,086	,070	,180**	,116*	,032	,131*	,108	,081	,089	,011	,033	,071	,135*	,169**	1	,139*
18	,197**	,210**	,117*	,130*	,093	,093	,105	,122*	,153**	,195**	,109	,095	,162**	,082	,149*	,048	,139*	1

1. With Covid-19; I tented towards activities that I could enjoy nature
2. With Covid-19; I started reading more books
3. Before the Covid-19 outbreak, I preferred indoor spaces more
4. After the Covid-19 outbreak, I prefer open spaces more
5. Even if the pandemic is over, I will continue to go to more open areas
6. My interest in nature has increased during the pandemic
7. After the pandemic outbreak, my interest in open spaces increased
8. I understood the value of nature more during the pandemic
9. The pandemic has taught me that I can be happy engaging with nature
10. I am aware that I am experiencing changes in my spatial preferences
11. Before the pandemic outbreak, my aesthetic concerns were more prominent in my spatial preferences
12. After the pandemic outbreak, spatial that give importance to ecological approaches started to attract my attention more

13. I need natural elements to be included in the interior during the pandemic
14. After the pandemic outbreak, I pay attention to the fact that the place I am in is large and suitable for social distance
15. After the pandemic outbreak, I give importance to the fact that a place I will go has a possibility of an open space
16. After the pandemic outbreak, I pay attention to the fact that the places I will go are spacious and hygienic
17. During the Covid-19, my city offered me enough
18. After the pandemic outbreak, I started doing sports outdoors/at home
**(p<0,01), *(p<0,05), N=289

In this stage of the study, the subject of whether it will change the future landscape architecture design concept and architectural profession disciplines was measured via the participants (Tables 9-10). The percentages are 33.4% agree, 19% strongly agree, 15.9% have no idea, and 5.7% disagree with the statement "*I think a new landscape architecture design approach should come after the pandemic is over*" (Table 9). The percentages are 30.6% agree, 20.1% strongly agree, 19.5% I have no idea, 3.1% disagree, 1% strongly disagree with the statement "*I think the pandemic has affected/changed the professional disciplines of architecture closely*" (Table 10).

Table 9. Measuring the change in landscape architecture design concept with the pandemic

I think a new landscape architecture design approach should come after the pandemic is over				
	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	74	19,0	25,6	25,6
Agree	130	33,4	45,0	70,6
Have no idea	62	15,9	21,5	92,0
Disagree	22	5,7	7,6	99,7
Strongly disagree	1	0,3	,3	100,0
Total	289	74,3	100,0	

Table 10. Measuring the change in the professional disciplines of architecture with the pandemic

I think the pandemic has affected/changed the professional disciplines of architecture closely				
	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly agree	78	20,1	27,0	27,0
Agree	119	30,6	41,2	68,2
Have no idea	76	19,5	26,3	94,5
Disagree	12	3,1	4,2	98,6
Strongly disagree	4	1,0	1,4	100,0
Total	289	74,3	100,0	

4. Discussion And Conclusions

Although there exist many publications about Covid-19 at the time, it is unknown how much more effective the disease will be (Cam 2020; Li et. al. 2021). So We need to rethink design principles every architectural disiplinces (Megahed and Ghoneim 2021). Governments have reacted to the Covid-19 by implementing self-isolation and physical distancing measures that have substantially affected daily life throughout the whole world (Hu et. al. 2021; Shakibaei et. al. 2021). Because before Covid-19 pandemic most of people live and work densely populated environments in urban areas. Whereas a significant number of evidences show that spending time in natural environments and frequent contact with nature can have positive effect on human health and wellbeing (Hartıg et. al. 2001; Zhang et. al. 2014; Aerts et. al. 2018). Among the changes experienced during the Covid-19, the "spatial preference changes" of people were examined via the participant of the online survey. As a result of this study architecture, interior design, landscape design and urbanism after the Covid-19 epidemic will never be the same.

In this study, it was questioned whether people in Turkey were affected by the restrictions in the Covid-19 process and spatial preferences before/after covid 19. To survey before the start of the pandemic outbreak, people mostly prefer to go to "cafes and restaurants (5,33) and the reasons for preferring these places are the "scenery characteristic (4,12)" and "various activities for children (3,18)". Also before the start of the pandemic outbreak, the rate of people choosing malls (3,56) is lower than the rate of going to open areas (5,18) and cafes (5.33). The reasons why people prefer spatial they go during Covid-19 are "scenery characteristic" (4,12)" and "presence of activities for children (3,18)" are among the important ones. When we look at this result, we can say that people pay attention to the natural scenery characteristic because they want to relax and breathe before Covid-19. At the same time, we can say that families make priority decisions for their children who have to spend the whole day in the house during the Covid-19 pandemic. The

spatial preferences rates have varied dramatically after Covi-19 pandemic. While 23.7% of people preferred to go to cafes and restaurants before the pandemic outbreak, 9% of the participants preferred to go to cafes and restaurants after the pandemic outbreak. Likewise, before the pandemic outbreak, 15.7% of the participants preferred to go to open areas, while after the pandemic outbreak, 41.9% of the participants started to prefer open areas. So Covid-19 infects from person to person with the contagion (Li et. al. 2021) people prefer open spaces where they can maintain social distance.

While 88% of the participants stated that they were psychologically affected by the outdoor restrictions, 58% of these answers belong to women and 42% to men. When we look at this result, we can say that women are affected more than men. Connor et. al. (2020) emphasize that due to reduced healthcare access experienced by many women are more sensitive to many psychologically issues.

We can see that the majority of the participants, who make up the 88% result, are "people who spend most of their time in front of a computer and a TV, and people who spend most of their time taking care of the house ". When we look at this result, we can say that people who are not interested in open areas and are mostly interested in electronic equipment and home are psychologically affected more by the Covid-19. This is due to the high risk of disease transmission outdoors and is the need for technological products in order to continue education or business life.
During the Covid-19, the participants made differences in their living spaces, some of them "bought kitchen equipment for cooking" with 36.2% and "strengthened the technological infrastructure for communication and education" with 26.5% (Table 6). The people, who spend most of his life in the house, has focused on improving his communication and food needs. Bracale et. al. (2020) say that increase in the consumption of pasta, flour, eggs, long-life milk and frozen foods, in comparison to a reduction of fresh food goods. People produce homemade bread, pizza and cakes more than normal at home in the Covid-19 process.

As a result of the factor analysis, during the determination of the changing preferences during the Covid-19, "With Covid-19; I tended towards activities that I could enjoy nature (0.748)", "I became more interested in my home (0.746)", "I discovered different places to go in the city I live in (0.650)" were found to be important factors. This is among the most important consequences of the pandemic. With this pandemic, we can say that "people are more oriented towards nature and they want to see more natural elements in their environment. With the correlation analysis, the strongest relationship between the factors was between the criteria "*With Covid-19; I found new hobbies*" and "*With Covid-19; I turned to activities that I could enjoy nature* (0,493**)". The next strong relationship is between "*With Covid-19; I moved away from indoor spaces* and "*With Covid-19; I turned to activities that I could enjoy nature* (0,450**)". When we look at these results, people get away from indoor spaces and find new hobbies in nature; we can say that it taught them to enjoy nature. This effect is a positive consequence of the pandemic on humans. This result obtained by correlation analysis is also supported by the factor analysis in Table 7. Similar results were obtained in Table 7. These results are as follows; "*The pandemic has taught me that I can be happy engaging with nature* (0,725)", "*My interest in nature has increased during the pandemic* (0,691)", "*I understood the value of nature more during the pandemic* (0,677)", "*After the pandemic outbreak, spatial that give importance to ecological approaches started to attract my attention more* (0,676)," and "*With Covid-19; I tented towards activities that I could enjoy nature (0,620)*". All these results show that the pandemic has changed the people's spatial preferences and made them more oriented towards nature.

The pandemic outbreak has created sharp changes and results in many areas all over the world. These changes have also affected landscape architecture and architectural profession disciplines, which have design understandings that will respond to people's needs and wishes (Tables 9-10). When we examine the results in Tables 9-10, 33.4% of the participants think that "*a new landscape architecture design approach should come after the pandemic outbreak*". This shows that new understandings will come in design profession disciplines as well as changes in other sectors. As a result; it can be concluded that the pandemic affects people in many ways in terms of spatial, life and psychological preferences. Researches and this study have shown that "nature" has taken on the role of being the closest friend of human beings in this pandemic outbreak. In other words, we can conclude that this negative process actually has positive awareness effects on people. The fact that people learn that they could also enjoy nature, prefer open areas more, and give more place to plants in their lives supports these results. When we consider all these results, we can conclude that the nature has been the most important shelter for human beings since their wellbeing and existence.

With the findings and results obtained in the study, the following suggestions can be made:

- Urban green areas with the potential to be used before and after the pandemic should be determined. These areas should be shaped in a sustainable way with solutions suitable for use in pandemic conditions.

- In spatial designs to be made for people, possible epidemics and disasters should be considered.

- Flexible spatial open to new normals should be designed as the current Covid-19 outbreak is not the first and will not be the last. Many previous disasters/epidemics in the world set an example for this.
- As the results of the study reveal, the positive effects of green areas on human psychology are very high. For this reason, green natural elements should be included more in indoor/outdoor designs.

- Today, people with a busy work schedule had to spend most of their days indoors as, with the use of technology in every field, most people are working on the computer in the office

environment. This pandemic outbreak, on the other hand, has forced these people to stay indoors even more and has had a negative psychological impact. As a solution to this problem, the use of more natural elements (plants, wood, natural stone, etc.) should be encouraged in the interior, and activity solutions with the social distance and without harm to nature in outdoor applications should be considered.

- The necessity of maintaining social distance in addition to

- outdoor restrictions during the pandemic is a harbinger of the
- need for new design approaches within urban green spaces (children's play area, urban furnitures etc.). In this sense, the outdoor activities of people should be determined and supported by sustainable urban landscape approaches.

- In the light of all this information, architecture, landscape architecture, urban planning, psychology etc. with multidisciplinary approaches space analysis should be carried out.

Acknowledgement

The author wishes to thank the anonymous reviewers for the constructive comments given during the review process and Bilecik Seyh Edebali University for the support in completing the research.

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IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 43-60

Assessing the Influence of Anthropogenic Causal Factors on Landslide Susceptibility in Bukit Antarabangsa, Selangor

Amos Mafigiri
Verdant Consulting Ltd, 10302 Kampala, Central Region, Uganda

Mohd Faisal Abdul Khan and Ami Hassan Che Din
Geospatial Imaging and Information Research Group (GI2RG), Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81300 UTM Johor Bahru, Johor

Muhammad Zulkarnain Abdul Rahman
Tropical Resources Mapping Research Group (TropicalMap), Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, 81300 UTM Johor Bahru, Johor

ABSTRACT

This study sought to assess the influence of causal factors related to anthropogenic activities on landslide occurrence in Bukit Antarabangsa, a township northeast of Kuala Lumpur in Ampang Jaya Municipal Council. Anthropogenic factors were chosen based on the township's rapid growth, numerous landslide records and intensity of hillside development. The study used a data-driven statistical model to identify factors most predictive of landslide occurrence based on an inventory of 20 landslides, and to evaluate the extent to which susceptibility was driven by factors related to urban development. A total of 17 factors were categorized into four clusters (geological, geomorphological, hydro-tographical and anthropogenic). Factor maps were classified to derive factor classes for each parameter. The dataset was then processed using a weight-of-evidence statistical model to determine the contrast value of each factor class. Contrast value (C) reflects the extent to which each factor class predicts landslide occurrence. The C-weighted factor maps were then combined to derive the landslide susceptibility index (LSI). The LSI enabled visualization of the spatial distribution of susceptibility based on a given combination of factors. Susceptibility maps were prepared for combinations containing only non-anthropogenic parameters and all landslide parameters. The study compared these combinations to determine the influence of anthropogenic factors on total LSI. Similar analyses were conducted to determine the effect of each anthropogenic factor on LSI. The results indicated that lineament density, distance to lineament and distance to road had a significant influence on landslide occurrence. A strong correlation with landslide occurrence was observed for land use/land cover, especially in high susceptibility zones, followed closely by the influence of one distance to road factor class. The results could be useful in planning infrastructure corridors in densely built-up landslide-prone areas.

Article History

Received : *04 August 2022*
Received in revised form: *02 December 2022*
Accepted : *02 December 2022*
Published Online : *31 December 2022*

Keywords:

Landslide susceptibility, causal factors, anthropogenic influence, weight of evidence, Bukit Antarabangsa

Corresponding Author Contact:

mdfaisal@utm.my

DOI: 10.11113/ijbes.v10.n1.1051

1. Introduction

Landslides are common in hilly and mountainous parts of Malaysia, and result in major losses of economic and environmental resources, including human fatalities (Akter et al., 2019). Landslide occurrence in Malaysia has been attributed to a number of factors, the most notable among these being design errors due to insufficient site-specific ground investigation (Kazmi et al., 2016). The prevalence of man-made causal factors ties in with Malaysia's rapid urbanization and

development of highland and hilly terrain (Nor Diana et al., 2021), and points to a possible trend towards development beyond control of land use. Numerous studies on landslide risk focused on geological, geomorphological, hydro-topographical factors, although the hydrological effect of vegetation on rainfall-induced landslides has been rarely assessed (Gonzalez-Ollauri & Mickovski, 2017). Geographical Information Systems (GIS) are applied to landslide disaster preparedness primarily through geospatial mapping to determine an area's landslide susceptibility, hazard and risk, which enables planning authorities to carry out appropriate zonation for urban development based on landslide risk.

This study focuses on landslide susceptibility, which is typically the first stage of landslide hazard and risk analysis (Dikshit et al., 2020). Landslide susceptibility addresses the question of "where could landslides occur?", and can be seen as an estimation of the spatial probability of landslide occurrence at a given location (Hervás et al., 2007). To date, there have been a number of studies on landslide susceptibility in Peninsular Malaysia, the majority of which have focused on natural (i.e. geological, geomorphological, hydro-topographical) and, to some extent, anthropogenic factors. What remains less clear is the link between slope instability possibly attributed to anthropogenic causal factors related to urban development and landslide occurrence.

In Malaysia, numerous studies have been carried out on landslide mapping and risk zonation; however, few have focused on aspects such as causal factor analysis, sensitivity analysis and socio-economic characterization (Akter et al., 2019). This challenge has been observed despite a growing acknowledgment that landslide occurrence is being driven by natural as well as anthropogenic factors. Land urbanization has been linked to an increased likelihood of landslides, largely due to physical disturbances that result in reduced vegetation cover and cutting of natural slopes (Li et al., 2017). While urbanization on its own does not necessarily increase the likelihood of landslide occurrences, the pressure for more land can lead to building in areas that are susceptible to landslides (Klimeš & Novotný, 2011).

The area of study, Bukit Antarabangsa in Ampang Jaya Municipal Council (MPAJ), is one of the most landslide-prone regions in Malaysia, and recorded six landslide events in the period from 1993 to 2014 (Akter et al., 2019). The consequences of landslide occurrences in this area range from damage of roads and residential property to loss of life (Nor Diana et al., 2021). Bukit Antarabangsa is also a rapidly growing peri-urban area with considerable hillside development. Recent studies of this area have highlighted construction design errors and precipitation as main causal factors of landslide occurrence (Kazmi et al., 2017). However, the rapid urban development of the area, and subsequent increase in surface runoff could play a role in the area's proneness to slope failure (Majid et al., 2020). In Bukit Antarabangsa, improper planning and the continued development of hilly areas have been cited as contributing factors arising from human activity (Shafie et al., 2013). While the geology of the area remains fairly stable, the ongoing urban expansion has led to deforestation, which has in turn exacerbated weathering and erosion (Hassaballa et al., 2014)). The lithology of this area is characterized by extensive weathering which has turned granite into residual soil and fully weathered material that is prone to rapid loss of consistency when highly saturated (Chigira et al., 2011). The area is also typified by undulating topography with presence of streams and rivers, and a high population density (Izumi et al., 2019). Land use ranges from natural forest recreational areas to commercial and residential developments. The ongoing urbanization of this area has been attributed to deforestation which has in turn resulted in weathering and erosion that are a threat to slope stability (Hassaballa et al., 2014).

This research seeks to assess the influence of anthropogenic causal factors on landslide susceptibility in a landslide prone area using a data-driven geospatial method. It seeks to determine whether or not approaches that address housing and infrastructure development can provide a basis for sustainable, low-cost landslide risk reduction in urbanized areas.

2. Methodology

2.1 Description of Study Area

The choice of Bukit Antarabangsa as the area of study is owed largely to its rapid urbanization and prominence as one of the major hot spots of landslide occurrence in Malaysia. The township is situated in Klang Valley, which is an economic powerhouse in the region and as a result continues to experience rapid urban expansion in spite of landslide prevalence. The study covers a 1.15 square kilometer area in the township of Bukit Antarabangsa on the northeastern extent of Ampang Jaya Town Council. This specific area was selected for its high density of landslides. Bukit Antarabangsa is a hillside township located in Ulu Klang District, Selangor State, and is under the jurisdiction of Ampang Jaya Municipal Council. It is centered at geographic coordinates 3°12′00″ north latitude and 101°46′01″ north of Kuala Lumpur (Figure 1).

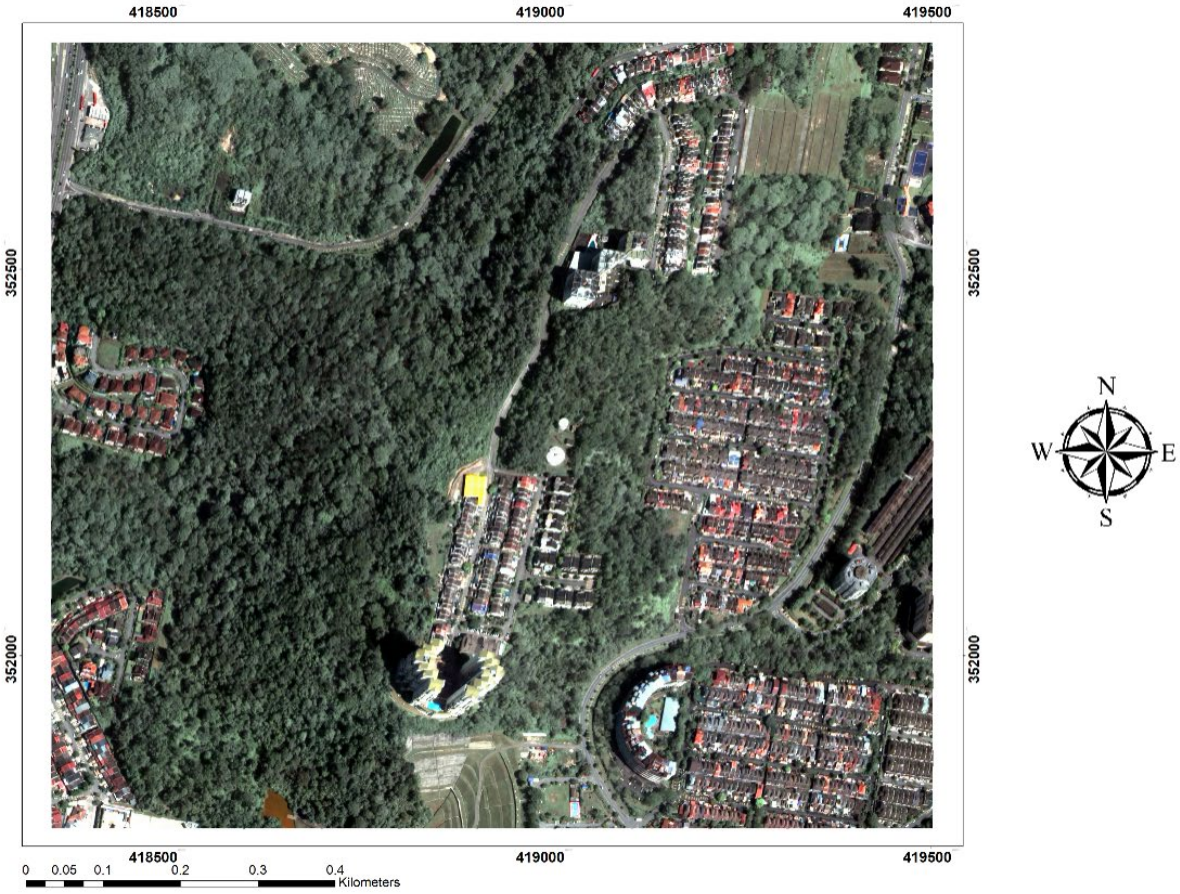


Figure 1 Study area in Bukit Antarabangsa (Ampang Jaya Municipal Council)

The township has witnessed a rapid increase in infrastructure development owing largely to its proximity to Kuala Lumpur (Hassaballa et al., 2014). Bukit Antarabangsa is a well-known landslide prone area and was selected for this reason. Recent significant events include December 1993, May 1999, November 2002 and December 2008. Several investigations conducted in the period following these incidents indicated that the landslide was the result of several factors such as loose soil from earth dumping during construction, a rise in ground water level due to extended rainfall in the months prior to the failure, sustained soil creep that expanded the existing cracks and created new tension cracks as well as heavily leaked active water pipe as a result of soil creep(Ismail et al., 2019). The 1993 landslide was responsible for the collapse of the Highland Tower condominium, which led to 48 fatalities. The occurrence of this landslide was partly attributed to presence of weathered granitic material which is porous, friable and inherits relict planes of weakness from the parent rock (Chigira et al., 2011). The 1999 landslide took place near Athenaeum Tower condominium. It did not result in any fatalities but cut off the access road to Bukit Antarabangsa and left many people trapped inside their homes. The failure was attributed to non-adherence to the minimum factor of safety requirements, inadequate slope drainage, weak material in the slope body, subsurface saturation by rainwater, vegetation removal due to dumping, and internal erosion of fill materials. The geologic setting of the study area is characterized by granitic rock, phyllite and schist, and limestone with minor intercalations of phyllite, with most landslides occurring on granitic rock formations (Lee et al., 2014). With a few exceptions in northern Europe and North America, granitic rocks in particular are known to be prone to weathering and thus are susceptible to landslide occurrence (Chigira et al., 2011).

2.2 Methods

This research was performed in the four major phases, namely selection of causal factors; data gathering and entry; data analysis; and model validation (Figure 2).

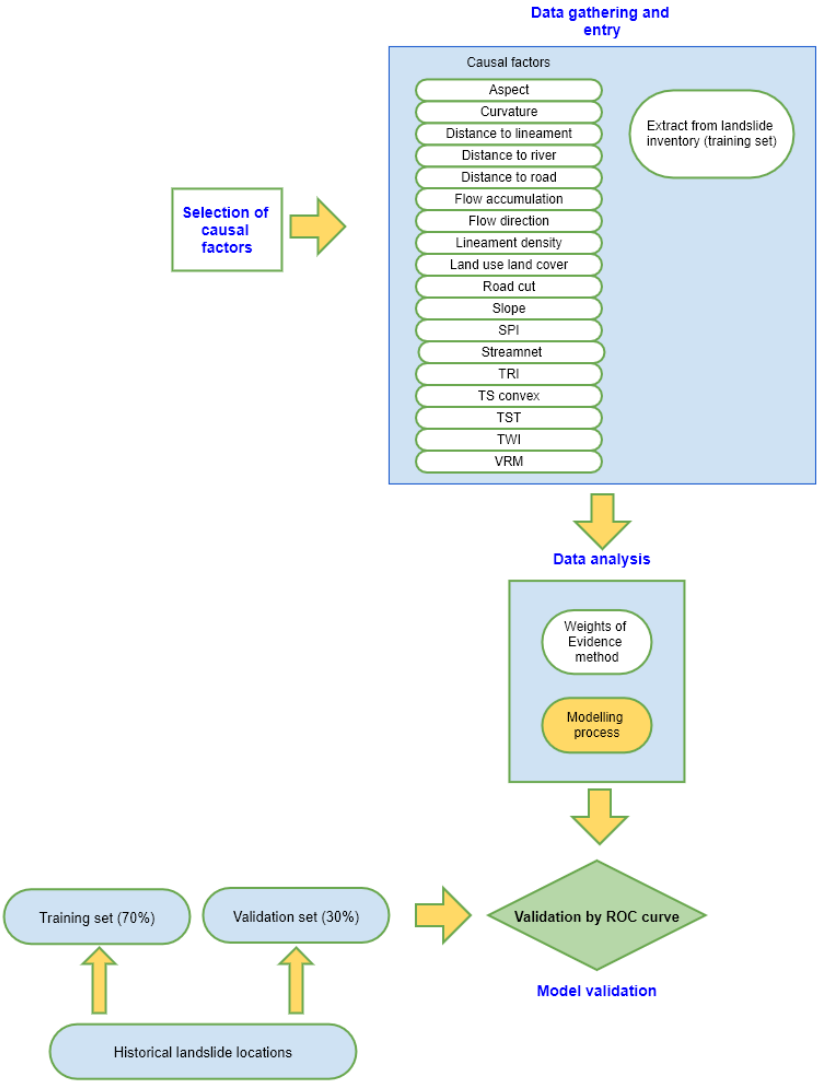


Figure 2 General method for the study

2.2.1 Selection of Causal Factors

The choice of factors was based on the review of guidelines and literature on the landslide mechanism and the causal factors specific to the area (Tian Huat et al., 2012); the selection also considers the availability of data. The study also considered Malaysian guidelines for prevention of slope failure related disasters (Raj, 2003) which highlight "rainfall, topography, drainage and vegetation cover" as four key factors related to the occurrence of slope failures. The landslide mechanism considered in this case is the shallow landslide and debris flows. It is worth noting that among the causal factors considered, only landslide conditioning factors are selected in line with recommendations for landslide susceptibility assessment. The thematic categories for landslide causal factors include geological; geomorphological; hydro-topographical; and anthropogenic factors. A description of these factors is presented in Table 1.

Table 1 Overview of Landslide Causal Factors

Factor group	Causal Factor	Description
Geological	Distance to lineament	The term lineament included faults, fractures and escarpments (Getachew and Meten, 2021). It expresses the surface topography of underlying structural features and denote regions of faulting or fracturing (Sonker et al., 2021). As a general principle, the potential for slope failure increases with a corresponding decrease in the distance to lineaments.
	Lineament density	Lineament density is defined as the quotient of the total length of all recorded lineaments and the area under study (Edet et al., 1998). The lineament density of a given area is indicative of landslide susceptible zones (Sonker et al., 2021). A higher lineament density value typically correlates with a higher landslide susceptibility class.
Geomorphological	Slope	Terrain slope or slope gradient determines the spatial distribution and intensity of landslide occurrences, and is one of the more important factors that influence landslide susceptibility. An increase in the angle of a slope compounds slope instability, leading to an increased tendency for landslide occurrence (Sonker et al., 2021). Additionally, slope gradient has an influence on the concentration of moisture and the level of pore pressure at the local scale, as well as hydraulic continuity at larger scales (Getachew and Meten, 2021).
	Aspect	Slope aspect has a considerable effect on slope characteristics such as vegetation cover, retention of moisture and soil strength (Khan et al., 2019). It determines the level of exposure of terrain to elements such as sunlight, wind and rain, which in turn determines the degree of weathering and soil moisture content (Getachew and Meten, 2021).
	Curvature	Curvature of a slope has an influence on surface runoff and therefore affects landslide occurrence (Nohani et al., 2019). The factor map for slope curvature is to be derived from a DEM, and classified into classes of negative and positive curvature.
	Stream power index (SPI)	Stream power index is a measure of the erosive power of a stream and is considered a key factor influencing slope stability (Regmi et al., 2014). The SPI value is determined by parameters of viscosity and steepness of terrain (Saadatkhah et al., 2015).
	Terrain roughness index (TRI)	The terrain roughness index, also known as terrain ruggedness index, denotes the degree of elevation difference between adjacent grid cells in a DEM (Riley et al., 1999). It is a measure of the general heterogeneity of a given area, and reflects the degree of surface erosion and variability (Shirvani, 2020).
	Terrain surface texture (TST)	Terrain surface texture defines the variability in regularity and intensity of pits and peaks within a given radius (Furze et al., 2021). It is defined specifically as the number of pits and peaks within a radius of ten cells (Iwahashi & Pike, 2007).
	Vector ruggedness measure (VRM)	Vector ruggedness measure provides a quantification of a given area's ruggedness by way of slope and aspect (Furze et al., 2021).
Hydro-topographic	Distance to river	This is sometimes referred to as distance to streams. Rivers and streams could influence landslide occurrence by wearing the slope base or saturating the lower horizons of hill slopes (Mousavi et al., 2011). This factor is intended to test the assumption that landslides occur more frequently along streams (Van Westen et al., 2003).
	Flow accumulation	Flow accumulation is a quantification of the land area that channels surface water to zones where surface water may accumulate (Dahal et al., 2008).

Factor group	Causal Factor	Description
	Flow direction	Flow direction displays the direction of flow out for every terrain cell in a digital elevation model, and is considered an important characteristic of mass flow (Fan et al., 2019).
	Stream network	Stream network was subdivided into four categories (Class 1, Class 2, Class 3 and Class 4); however, this parameter was not used in the analytical model as it did not coincide with any landslide locations.
	Topographic wetness index (TWI)	Topographic wetness index reflects the tendency of water to accumulate at any point within a given catchment (a) in relation to the tendency for gravity to move the water downslope (β). It is calculated using the formula: $TWI = \ln\left(\frac{a}{\tan\beta}\right)$ (Regmi et al., 2014).
Anthropogenic	Distance to road	Road networks have a major role in influencing landslide concurrence (Mousavi et al., 2011). Construction of roads along slopes results in a decrease of the slope base, and road ditch infiltration can contribute to an increase in soil moisture. This factor map is widely used as a test of whether or not landslides occur frequently along roads, and accounts for anthropogenic activities such as poorly designed cut-slopes and roadside drainage (Van Westen et al., 2003).
	Land use land cover	Land use land cover has a significant influence on slope stability as it influences characteristics such as infiltration, runoff production, runoff production and mechanical reinforcement of soil by vegetation (Moresi et al., 2020). The LULC map is to be classified into classes such as green area, water bodies, developing area and built up area following selection of an appropriate classification scheme.
	Road cut	Road cuts expose joints and fractures that can make a slope unstable, and are often the sites of human induced instability (Regmi et al., 2014). The road cuts are to be represented as buffers around roads situated on steep slopes.

2.2.2 Data Gathering and Entry

The data gathering and data entry phase included data gathering, database design, and data manipulation. The data were gathered from the sources primarily comprising government agencies in Malaysia. These included the Mineral and Geoscience Department; Ampang Jaya Municipal Council; and the Public Works Department. The datasets with which the geodatabase was constructed included a set of 18 raster map files; landslide inventory shape file; boundary shape file for the study area; and 8 orthophoto raster files. The database was created in ESRI ArcGIS 10.8, initially with sub-folders for manipulated factor maps and landslide inventory-derived polygons. The database was built upon iteratively during subsequent phases to include the outputs of data manipulation such as resampled factor maps and reclassified factor maps.

Following the construction of the study geodatabase, pre-analysis data manipulation was carried out in order to ensure that -all factor maps and layers are projected to the same spatial reference and aligned with the study area boundary, and all input raster layers had the same cell size; all factor maps are reclassified using an appropriate classification method; extraction of training and validation datasets from the landslide inventory is performed. Resampling of factor maps to the 5m by 5m cell size was then carried out using a "bilinear" sampling method for continuous data such as slope, curvature and distance to river while a "nearest neighbor" method was used for categorical data such as land use land cover, aspect and flow direction. For the reclassification of factor maps, continuous data variables were reclassified using the "natural breaks (Jenks)" method, with the exception of highly skewed datasets namely flow accumulation and SPI. The natural breaks method was selected for its ability to minimize variance within groups of data, thus allowing for higher degree of homogeneity within the factor classes (Polykretis et al., 2015). For these exceptions, a "geometric interval" classification method was used in order to enable a more balanced distribution of factor classes across the study area.

The training dataset comprised 70% of landslide polygons in the study area, with 30% of polygons providing the validation dataset (Figure 3). Prior to extraction of the training and validation datasets, an operation was executed to extract zones of landslide initiation that were used for the analytical model.

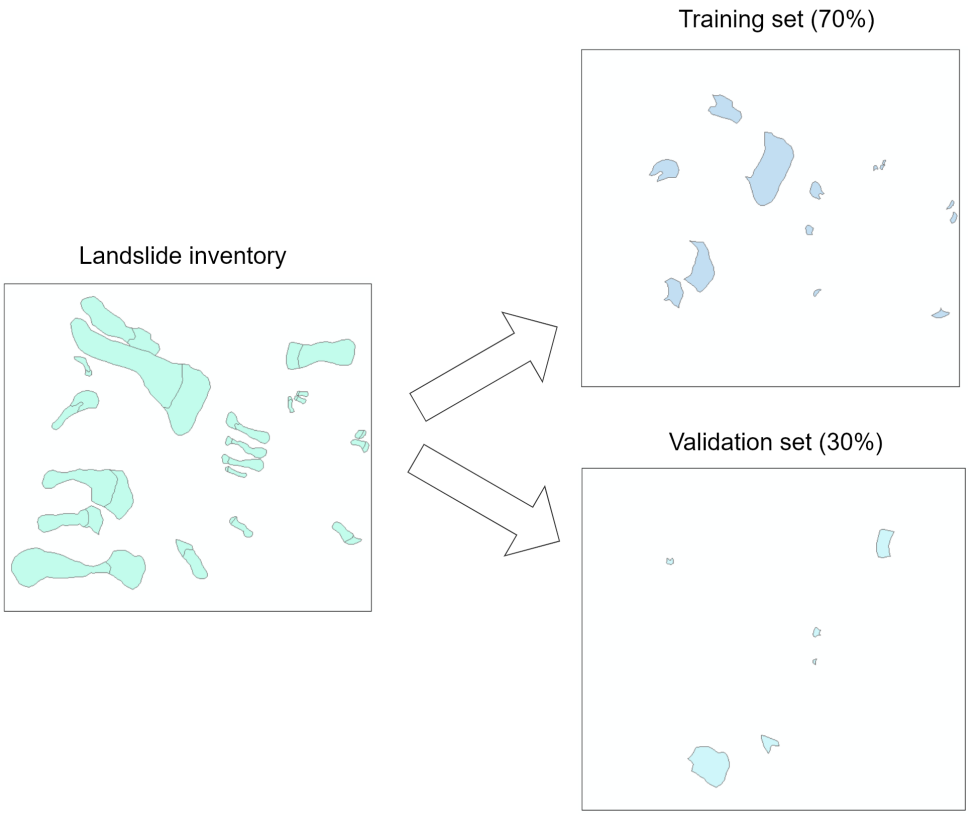
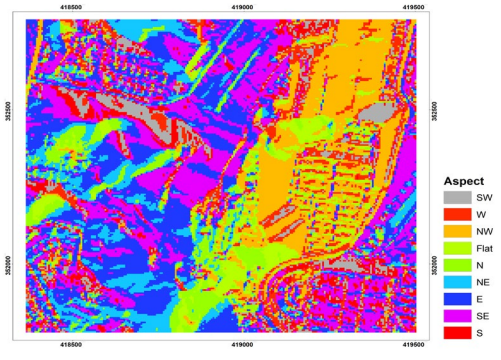
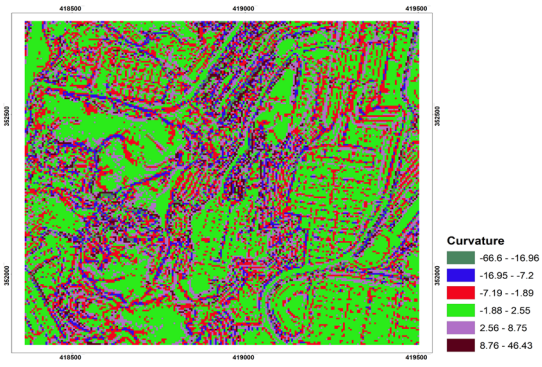


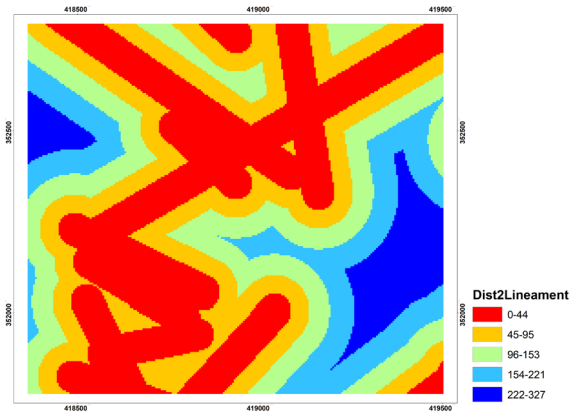
Figure 3 Results of extraction of training and validation sets

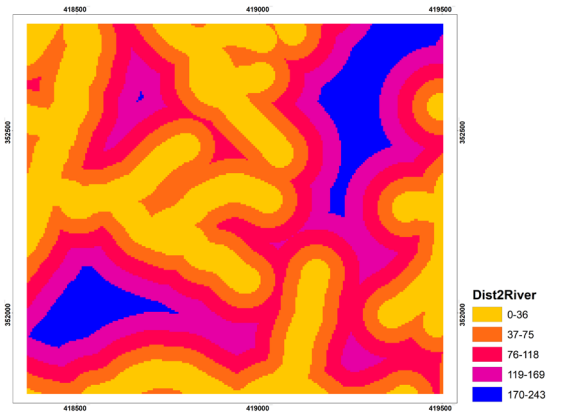
2.2.3 Data Analysis

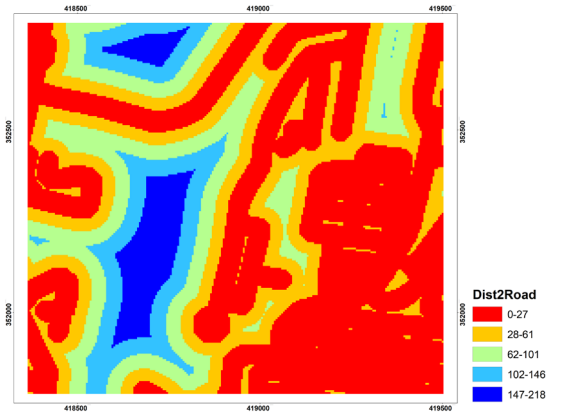
A total of 18 causal factor maps were examined during the data analysis phase. One of these factors was subsequently left out of the analysis due to deficiencies in the data. This was the stream network dataset which was excluded because it did not coincide with any landslide locations in the training set which would have yielded null values. The 17 classified factor maps are presented in Figure 4.

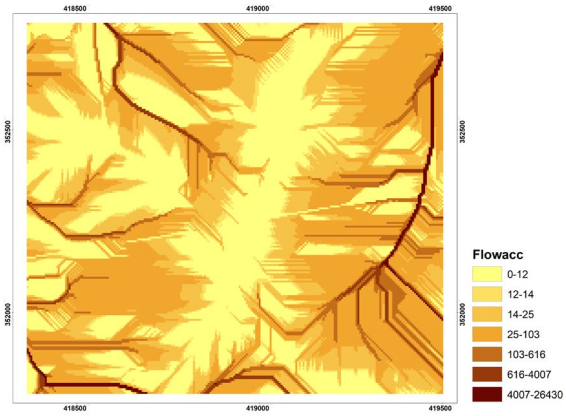





418500
419000
419500
352500
352000
Dist2Lineament
0-44
45-95
96-153
154-221
222-327


418500
419000
419500
352500
352000
Dist2River
0-36
37-75
76-118
119-169
170-243


418500
419000
419500
352500
352000
Dist2Road
0-27
28-61
62-101
102-146
147-218


418500
419000
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352500
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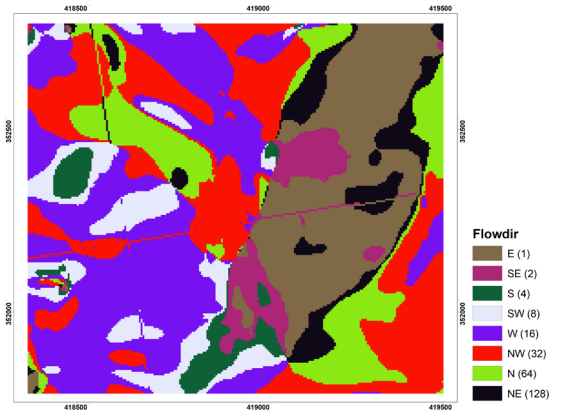
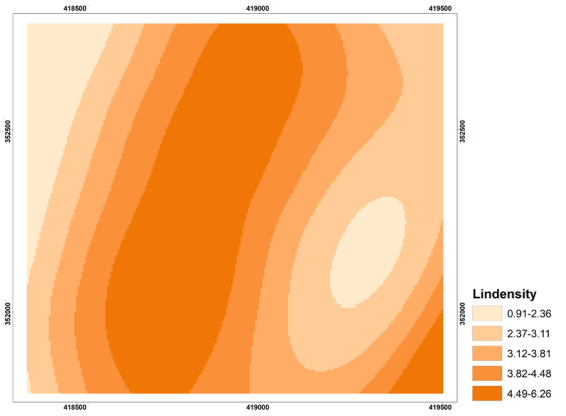
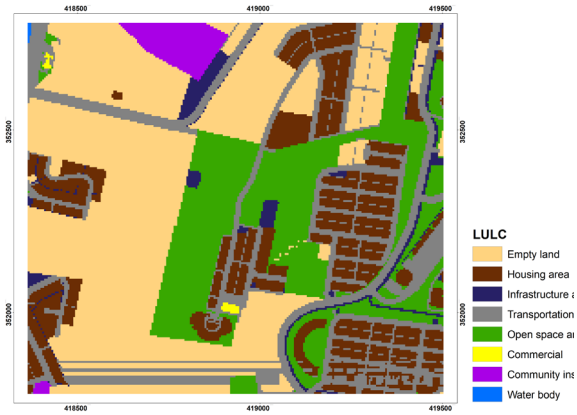
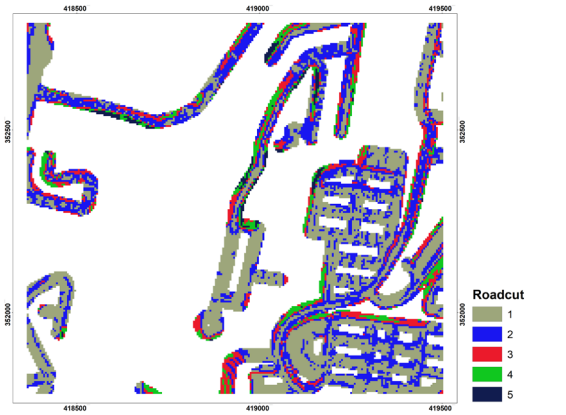
Flowacc
0-12
12-14
14-25
25-103
103-616
616-4007
4007-26430


418500
419000
419500
352500
352000
Flowdir
E (1)
SE (2)
S (4)
SW (8)
W (16)
NW (32)
N (64)
NE (128)


418500
419000
419500
352500
352000
Lindensity
0.91-2.36
2.37-3.11
3.12-3.81
3.82-4.48
4.49-6.26


418500
419000
419500
352500
352000
LULC
Empty land
Housing area
Infrastructure a
Transportation
Open space a
Commercial
Community ins
Water body


418500
419000
419500
352500
352000
Roadcut
1
2
3
4
5

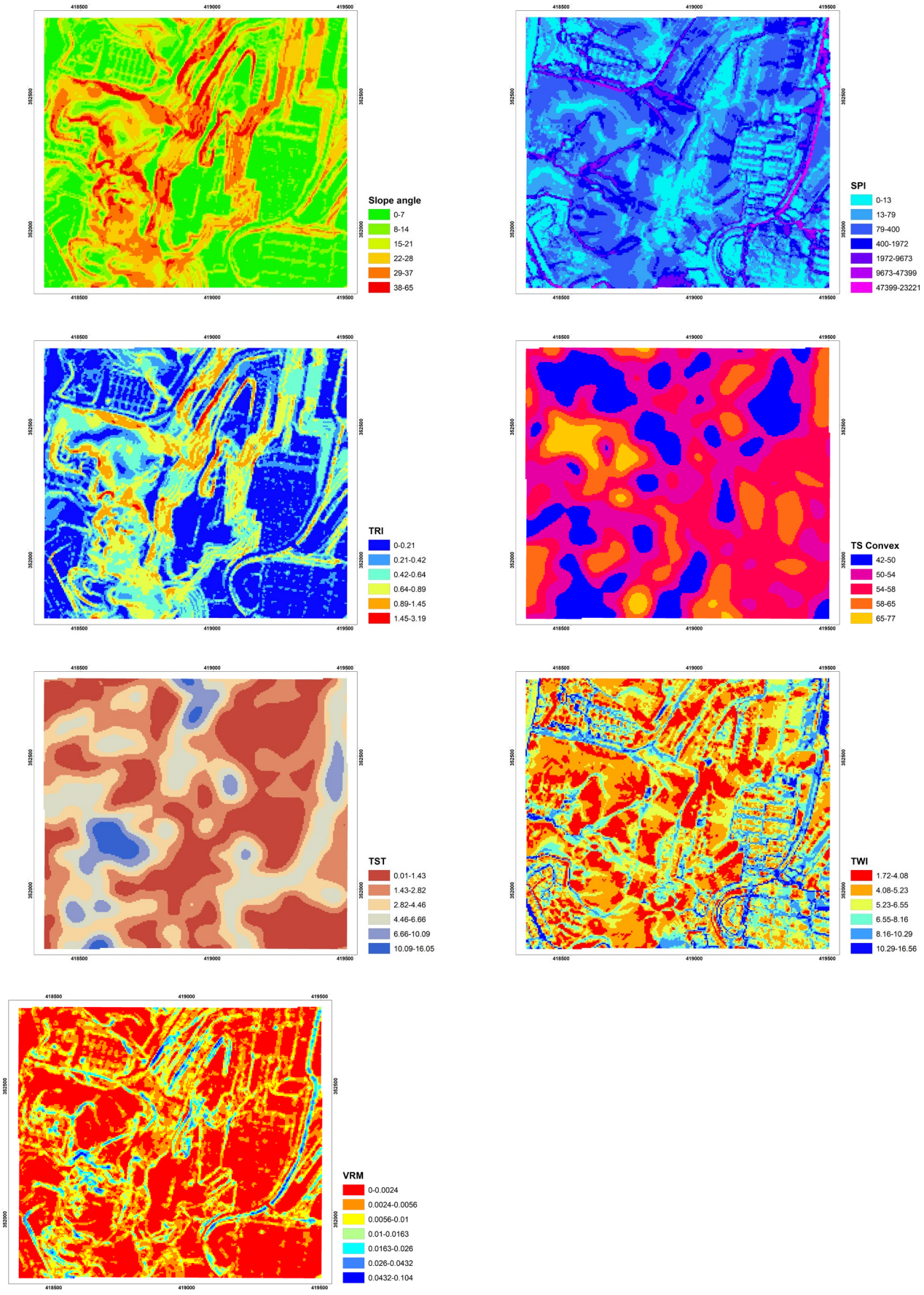


Figure 4 Causal factor maps used for the analysis

The weight of evidence method is based on Bayes theorem and concepts of prior and posterior probability. This approach aims to calculate the importance of each causal factor through a statistical technique, and to determine if a given set of causal factors could result in unstable slopes. It achieves this by assessing the spatial relationship between the areas affected by landslides, the known landslide locations, and the distribution of landslide related factors. The WoE method produces binary maps that aim to predict the presence or absence of the landslide event within each pixel. Each overlay of a given factor map layer and landslide inventory layer generates four possible combinations of landslide conditioning factors shown in Table 2.

Table 2 Possible combinations of a potential landslide conditioning factor. Note: Npix = number of pixels (Van Westen et al., 2003)

		B_i :Potential landslide conditioning factor	
		(Present)	(Absent)
S: Landslides	Present	Npix1	Npix2
	Absent	Npix3	Npix4

The study then assigned a weight to each factor class through a calculation of log-likelihood ratios (Equations 1 and 2) (Armas, 2012). The method allocates positive and negative weights to each factor class, for example the 0-7 degree slope class in a classified slope raster. A high positive weight indicates that a given factor class is highly predictive of landslide occurrence, while negative weights are less predictive of landslide concurrence (Getachew & Meten, 2021).

$$W^+ = \ln\left(\frac{\frac{Npix1}{Npix1+Npix2}}{\frac{Npix3}{Npix3+Npix4}}\right) \quad (1)$$

$$W^- = \ln\left(\frac{\frac{Npix2}{Npix1+Npix2}}{\frac{Npix4}{Npix3+Npix4}}\right) \quad (2)$$

A self-developed tool was used to extract the Npix1 values using a cross-factor operation to determine the number of landslide pixels within each factor class (Figure 5).

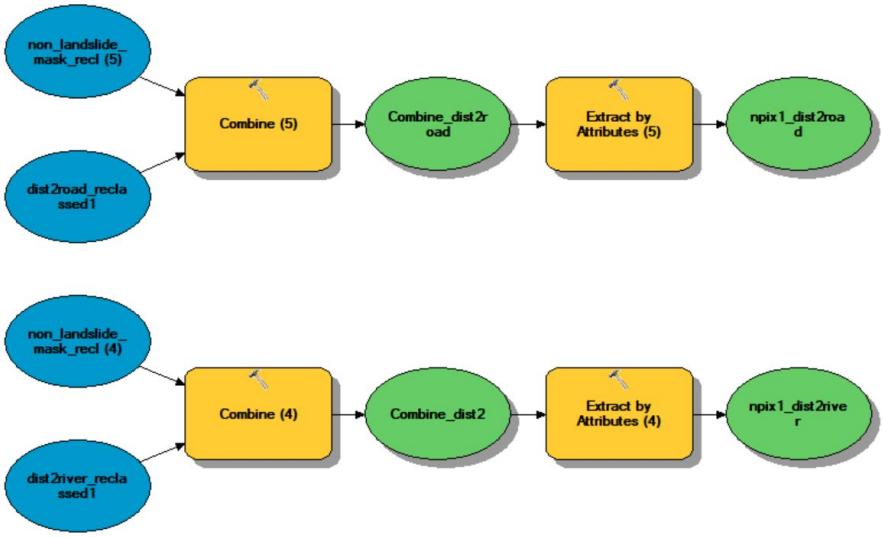


Figure 5 Model Builder tool for extraction of Npix1 grid cells

Once the values of Npix 1 were determined, the remaining values of Npix2, Npix3, and Npix4 were derived using the following formulas:

$$Npix2 = Nslide - Npix1 \quad (3)$$

$$Npix3 = Nclass - Npix1 \quad (4)$$

$$Npix4 = Nmap - Nslide - Nclass + Npix1 \quad (5)$$

From here, positive weight (W+) and negative weight (W-) values could be derived using Equations 1 and 2. A raster calculator operation was carried out to apply weight values to each factor class within the factor map layers. With the W+ and W- weighted layers, contrast value (C) layers (W+ - W-) were then derived for each factor map. Finally, all C-weighted maps were added up to generate the LSI map denoted by the equation:

$$LSI = \sum_{0}^{i} C_j \quad (6)$$

Where LSI is the landslide susceptibility index of the ith pixel and Ci is the contract value of the jth factor (Ilia & Tsangaratos,

2016). In order to create comparable LSI maps to enable assessment of the influence of anthropogenic factors, the final LSI values were categorized into five classes using a natural breaks classification method (Polykretis et al., 2015). The classes were ''Very low'', ''Low'', ''Moderate'', ''High'' and ''Very high''.

Following this classification, a set of LSI maps were prepared for different factor combinations including all 1) available factors; 2) and non-anthropogenic factors. Subsequently, map algebra subtraction operations were performed first to determine the influence of anthropogenic factors on the overall LSI (inclusive of all available factor maps), then through a raster operation, the difference that a single anthropogenic factor made to overall LSI.

A receiver operating characteristics curve was then drawn and the area under curve calculated. The ROC analysis is noted to be a robust method for validation of landslide susceptibility models (Polykretis et al., 2015). The validation was carried out with the remaining 30% of landslide polygons.

3. Results and Discussion

The data analysis performed a weight of evidence calculation, which determined positive and negative weights as well as contrast values for all factor classes. These values were the basis of the evaluation of factor significance. According to Getachew and Meten (2021), positive weight values between 0.1 and 0.5 are considered middle predictive, while values between 0.5 and 1 are deemed moderately predictive. Values between 1 and 2 are considered highly predictive of landslide occurrence. As such, the highest positive weight values were ranked in order to identify the most highly predictive factor classes, which might point to the most significant causal factors. These results are presented in Table 3.

Table 3 Highest ranked factor classes by contrast value

Causal factor	Factor class	W+	W-	C
Lineament density	4.49-6.26	1.152	-1.415	2.567
Distance to lineament	0-44	0.991	-1.547	2.538
Distance to road	147-218	1.741	-0.277	2.018
	62-101	0.892	-0.302	1.194
Road density	12.44-19.01	0.684	-0.515	1.199
	19.01-28.47	0.7152	-0.3571	1.072
Slope	38-65	1.752	-0.198	1.950
	29-37	1.096	-0.341	1.437
TRI	0.89-1.45	1.566	-0.259	1.825
	1.45-3.19	1.437	-0.018	1.455
	0.64-0.89	0.953	-0.365	1.318
Flow direction	W (16)	0.995	-0.875	1.870
Land use/land cover	Open space and recreation	0.895	-0.426	1.321
TST	6.66-10.09	1.091	-0.104	1.195
Aspect	East	0.790	-0.346	1.136

The results indicate strong positive correlations (W+) in factor classes for distance to road, lineament density, slope, TRI, and TST factors. Moderate to highly predictive anthropogenic factor classes included LULC classes (infrastructure and utilities and open space and recreation); distance to road (147-218m); road density; and distance to multi-storey buildings (81-157m). Medium to moderately predictive classes for non-anthropogenic factors included the east, northeast and southeast-facing slope classes for aspect; negative (-66.6 - -16.96 and -16.95 - -7.2) and positive (8.76 - 46.43) curvature classes (0.6843- 0.7092); 0m-44m distance to lineament (0.9906); 37m-75m distance to river (0.5757); flow accumulation (12-14 and 14-25); (SW) flow direction (0.9946); 50-54 TS convex (0.6704); 1.72-4.08 TWI (0.5278); and four of six VRM classes (0.4332-0.9719). Highly predictive classes for non-anthropogenic factors included highest (4.49-6.26) lineament density (1.1517); highest (29°-37°, 38°-65°) slope classes (1.0956 and 1.7522); 400-1972 SPI (1.1032); highest TRI values (1.5663 and 1.4372); 6.66-10.09 terrain surface texture (1.0914).

3.1 Output for All Causal Factors

The main output of the model was a set of susceptibility maps representing different factor combinations from which the influence of anthropogenic factors may be assessed. The main outputs included 1) a susceptibility map classified from the LSI of all landslide causal factors (Figure 6); and 2) a susceptibility map classified from the LSI of non-anthropogenic factors (Figure 7). The results indicate that overall, susceptibility within the study area is high and the highest susceptibility class correlates significantly with the high lineament density and TRI.

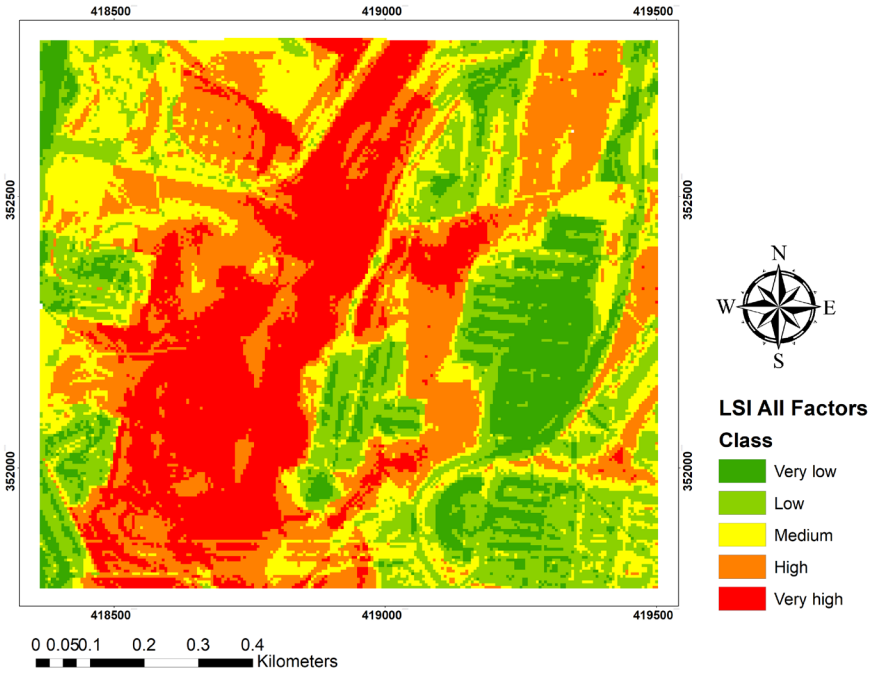


Figure 6 Susceptibility map derived from LSI of all landslide causal factors

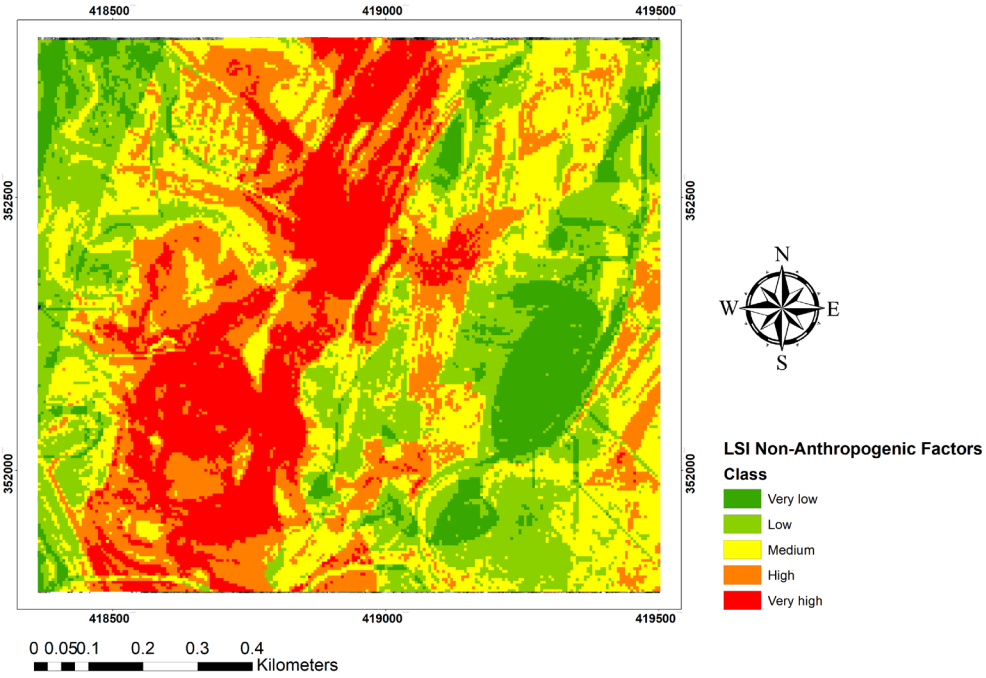


Figure 7 Susceptibility map derived from LSI of non-anthropogenic landslide causal factors

3.2 Influence of Anthropogenic Factors

A separate raster layer was processed to help visualize the incremental change in susceptibility when anthropogenic factors are added to the non-anthropogenic dataset. The results show the areas where anthropogenic factors had the highest influence on susceptibility (Figure 8). These areas were situated in the "High" to "Medium" susceptibility classes in the eastern and western peripheries of the study area, but were outside the "Very high" susceptibility class in the central to southwestern zone. Overall, the difference in susceptibility class value for any given pixel ranges from -2 to 2. The zones with "High" to "Medium" susceptibility lie closer to residential developments on the eastern and western peripheries of the study area. It was observed that while the addition of anthropogenic factors did not affect "Very high" susceptibility areas, it did alter considerably the extent of the "High" susceptibility areas. However, the most significant increases in LSI were noted to occur within areas that overlay with the highest weighted LULC and distance to road classes indicating further that these were the most important anthropogenic factors in the overall dataset.

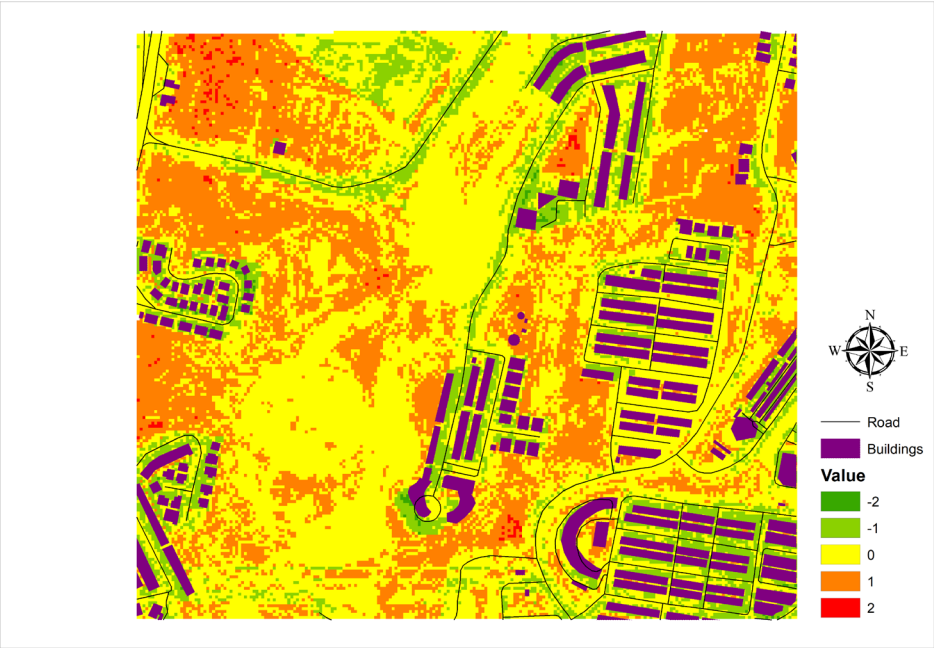


Figure 8 Illustrating the incremental change in LSI when anthropogenic factor layers are added to the dataset

3.3 Influence of a Single Anthropogenic Factor

In this step, a subtraction was carried out to determine the susceptibility values for a single anthropogenic factor, which is distance to road. This was intended to highlight the incremental effect that a single anthropogenic factor can have on susceptibility. The results of this analysis are presented in Figure 9. They indicate that the addition of distance to road to total LSI had a marginal effect across the study area with susceptibility values increasing or lowering by only one class. The spatial extent of these shifts in susceptibility class was also small relative to other anthropogenic causal factors. In relation to the highest weighted causal factors, the values indicate a close spatial association with distance to road, TRI and distance to lineament causal factors.

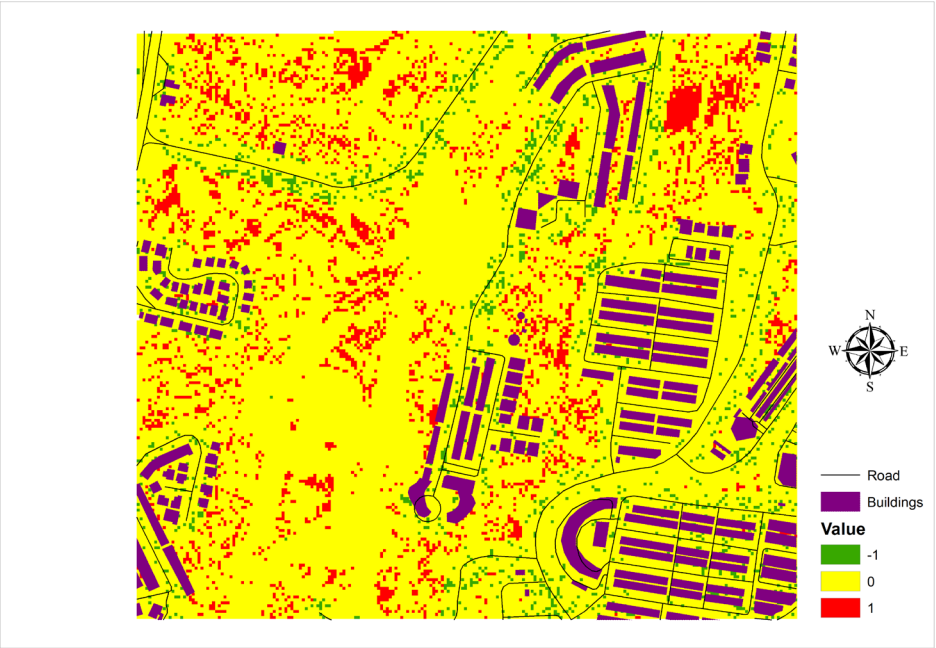


Figure 9 Incremental change in susceptibility class following addition of the distance to road layer

A similar function was executed for land use land cover. Both distance to road and land use land cover registered a change in susceptibility value ranging from -1 to 1. In the case of land use land cover, a similar pattern was observed wherein increase in susceptibility class due to addition of the single factor occurred in the "Medium" and "High" susceptibility classes. These zones were also located closer to residential developments (Figure 10). In relation to the highest observed factor classes, these areas showed a spatial association with LULC and distance to lineament layers.

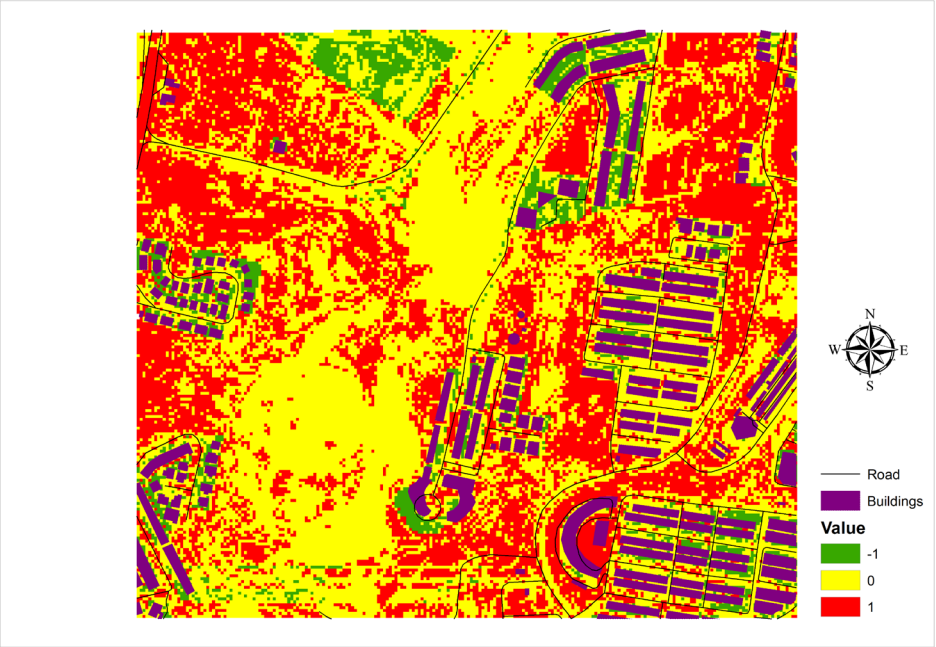


Figure 10 Incremental change in susceptibility class due to addition of land use land cover

The road cut layer registered similar results in terms of the range of susceptibility class differences, although the extent of the changes, specifically "High" and "Medium" susceptibility areas was noticeably larger than distance to road but smaller than LULC (Figure 11). The incremental effect for the road cut layer showed a close spatial association with highest weighted classes for distance to road and distance to lineament as well as LULC. These results appear to confirm the importance of land use as a significant factor in the morphology of slopes (Armas, 2012

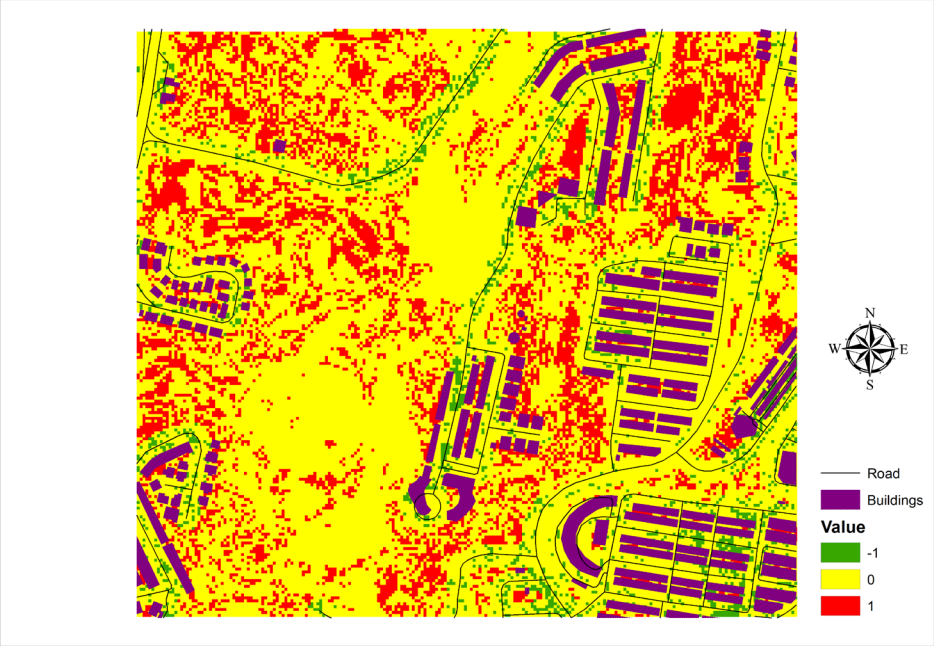


Figure 11 Incremental change in susceptibility class due to addition of road cut

3.4 Validation of the Susceptibility Model

The results indicated an AUC of 78.57% for all causal factors and 78.67% for non-anthropogenic factors, which was considered a good accuracy level (El Khouli et al., 2009) (Figure 12). The anthropogenic factors however, yielded an AUC of 57% which was a low level of accuracy by comparison.

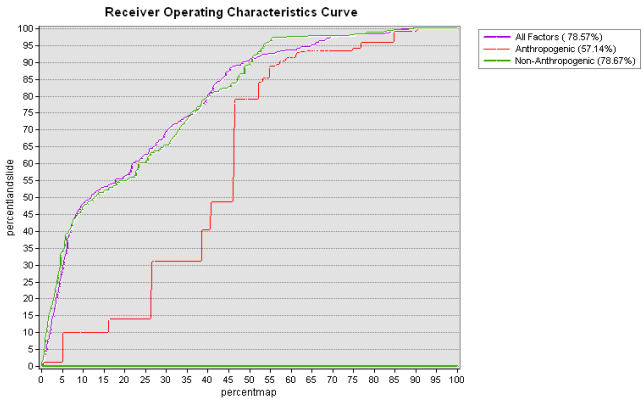


Figure 12 ROC curve for all landslide causal factors, anthropogenic factors and non-anthropogenic factors

4. Conclusion and Recommendations

The results indicate that while anthropogenic factors contribute considerably to landslide susceptibility, their influence on the cumulative LSI value is comparably less prominent than that of non-anthropogenic factors, specifically geological and geomorphological factors. Additionally, among anthropogenic causal factors, land use/land cover and distance to road have the biggest influence in landslide susceptibility. Specifically, zones in the open space and recreational area factor class show a strong spatial association with steeper slope classes (29°-65°) and higher TRI values. This might indicate that areas inherently prone to slope failure due to higher slope angles are also less built-up. These forested slopes constitute the zones of highest susceptibility ("High" and "Very high") in the LSI map. A possible reason for high susceptibility within these zones - as put forward in a study by Hassaballa et al. (2014) - is that areas covered by forest carry more moisture, and thus are more prone to soil saturation. Conversely, impervious surfaces that characterise built-up areas show low soil moisture content. Distance to road classes 62m-101m and 147m-218m were also noted to have a strong correlation with landslide locations. The analysis also found that although distance to road factor classes had the highest contrast value among the anthropogenic factors, the incremental effect of land use land cover on LSI was more widespread across the study area, and followed respectively by road cut and distance to road. The results indicate further that anthropogenic factors have a relatively lesser influence on the "Very High" susceptibility classes (undeveloped forested slopes that constitute 17.75% of the study area) but are more influential in the built-up areas. The anthropogenic factors had a significant effect on the spatial extent of areas in the "High" susceptibility class (22.1% of the study area). The most significant increases in LSI were noted to occur within areas that overlay with the highest weighted land use/land cover and distance to road classes indicating further that these were the most important anthropogenic factors in the overall dataset. An examination of the influence of each anthropogenic factor showed that land use/land cover had the largest incremental effect on landslide susceptibility across the study area, thus underpinning its significance in the morphology of slopes (Armas, 2012).

The limitations of the research relate primarily to the constraints of the model, and the number of anthropogenic factors used for the study. The limitations of the model are that first, it considers only the spatial distribution of landslide occurrence, thereby omitting information about the

historicity of terrain units in relation to multiple landslide events (Corominas et al., 2013). Studies on the spatial-temporal distribution of landslides are one way to remedy this issue, and have been highlighted as a knowledge gap and opportunity for new research (Akter et al., 2019). Owing to constraints in the availability of data, this study excluded an in-depth look into other environmental factors such as vegetation and soil characteristics, which also bear significantly on slope stability. Specifically, vegetation cover has a strong influence on soil moisture, saturation and ultimately ground water level, all of which have an impact on slope stability, and are particularly relevant in the context of a rapidly developing urban landscape. Similarly, lithological characteristics were left out of the analysis due to the lack of spatial variance within the study area (only one lithological unit). This, however, limited the consideration of weathering and associated processes as a conditioning factor of landslide occurrence.

The study sheds light on the influence of anthropogenic landslide conditioning factors at larger scales within densely populated hillside settlements. It indicates that while the overall influence of human-related factors is peripheral in comparison to geological and geomorphological factors, the effect of infrastructure, particularly roads, is significant. Additionally, the study further highlights the significance of infrastructure development activities particularly road development on slope stability, and reinforces the principle that any activities or processes affecting the natural morphology of slopes will increase an area's proneness to landsliding. The study also indicates that anthropogenic factors could indirectly affect landslide susceptibility in the neighborhood of built-up urban spaces. It indicates that where impervious surfaces in built-up areas surround steep forested slopes, increases in soil moisture from the accumulation of runoff could increase landslide susceptibility on such slopes. Anthropogenic causal factors are also observed to have a more extensive effect on landslide susceptibility in built up areas, particularly land use land cover.

This study recommends that future research conducts a more in-depth analysis of anthropogenic factors, with a specific emphasis on non-conventional factors, for example building characteristics such as building type. Similarly, conventional factors such as roads may be expanded upon to include a classification of roads by attributes like pavement type, width and drainage among others.
Subsequent studies may also investigate the influence of these and other anthropogenic factors using a spatial-temporal approach in order to investigate links between the temporal distribution of landslide incidents and anthropogenic pressures. On the other hand, the spatial approach may be enhanced by a consideration of landslide activity attributes, which is to say, a similar spatial approach may divide the landslide inventory data into several input datasets categorized as dormant, active or potentially reactivated landslides. Further works should also consider different susceptibility scenarios based on landslide type, as these are driven by a unique set of causal factors (Van Westen et al., 2003).

The present study is important in the context of infrastructural development in the Kuala Lumpur peri-urban areas as it highlights the importance of road corridors and their influence on slope stability within landslide-prone regions. It also emphasizes the need for better approaches to protect steep, potentially unstable slopes from surface runoff.

Acknowledgements

The authors sincerely acknowledge the support of Geospatial Imaging and Information Research Group (GI2RG), Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia.

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IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 61-72

GIS-Based Vulnerability Analysis for Sustainable Fish Drying Cottage Industry in Southern Province, Sri Lanka

Githmi Abeysooriya
Department of Estate Management and Valuation, University of Sri Jayewardenepura, Sri Lanka

K.G.P.K. Weerakoon
Department of Estate Management and Valuation, University of Sri Jayewardenepura, Sri Lanka

ABSTRACT

Dried fish manufacturing is a famous cottage industry in Sri Lanka. Due to various natural and manmade reasons, their locations are not set up in sustainable ways. As a result, industry locations have become more vulnerable. Therefore, hurdles are there to sustainably expanding this cottage industry. So, the industry's novelty and the enormous number of issues experienced have yet to be discovered or solved via research study. Therefore, the current study intends to conduct GIS-based vulnerability analysis of the fish drying cottage industry by identifying the socioeconomic, environmental, and industry-related backgrounds of existing manufacturers and the industry, challenges faced by manufacturers, and vulnerable sites in the village using geo-spatial analysis. The case study focuses on Kudawella of Tangalle local authority, in the southern province of Sri Lanka. Qualitative analysis was used to identify the existing situation using a structured questionnaire survey and descriptive analysis was performed on the obtained information. The constraints were revealed by a content analysis of qualitative data acquired from a judgemental sample via semi-structured and unstructured interviews. Furthermore, the relative positions of the cottages were determined using OpenStreet Map and the absolute coordinates of a sample of 27 cottages gathered using GPS. A Weighted Overlay Analysis was performed using Arc Map 10.8 to create a Vulnerability Index Map to identify vulnerable locations for the industry while taking nine socioeconomic and environmental parameters. The outcome indicated four categories of vulnerability: severe, moderately severe, moderate, and low vulnerability, with 4.13% of the village falling into the severely susceptible category. The index map assists relevant authoritative organisations in making industrial decisions to attain sustainability based on the amount of risk and underlines the importance of institutional and individual decision-making systems.

Article History

Received : *04 August 2022*
Received in revised form: *02 December 2022*
Accepted : *02 December 2022*
Published Online : *31 December 2022*

Keywords:

Fish Drying Cottage Industry, GIS, Geospatial Analysis, Vulnerability Analysis; Vulnerability Index Map

Corresponding Author Contact:
kgpk@sjp.ac.lk

DOI: 10.11113/ijbes.v10.n1.1058

1. Introduction

The cottage industry alludes to the ancient artisanship of rural communities that make a variety of home objects out of locally accessible raw elements and creative talents passed down through the generations (Tasneem and Biswas, 2014). They handcraft creative objects representing the patterns and concept of nature and its individuals, birds and animals, foliage, plants and trees, lakes, streams, and sky for their personal use and income (McDonald, 2019). However, cottage industries offer economic possibilities for the poor and middle classes across the world, particularly in low-income and economically undeveloped

regions, through occupation and revenue creation programmes (Hareven, 2003). Handicrafts, artistic activities in timber and steel, amateur artworks, and rural agro and fish-based businesses are all considered to be part of the cottage industry. The cottage business has now spread throughout the metropolis, with the fish drying cottage industry being the most popular (Akter et al., 2018).

Drying is a well-known approach to preserving fish and an alternate approach to decreasing post-harvest wastage. The selection of appropriate fish, washing, separation of inside organs, salting, and drying are the main distinct steps of the dried fish production system. Dried fish is more prominent in developing countries than in advanced industrial countries, and the top dried fish manufacturers in Asia are Bangladesh, Thailand, India, and China (Omoruyi & Eronmhonbor, 2017). Hence, a cottage business focused on value-added fish products gives job possibilities while also assisting impoverished people's food security. Dried fish is quite popular among Sri Lankans, and there is considerable interest in them, particularly among rural residents who do not have access to fresh fish of excellent quality (Rupasena, 2014). While Sri Lankans' overall dried fish intake changes year to year, the typical yearly consumption stays about 90,000 Mt. Household-level manufacturers on a large, medium, and small basis is disseminated. The coastline strip of Sri Lanka caters for approximately 60–63 percent of the country's dried fish requirement, primarily through traditional manufacturing processes (Silva et al., 2013). Since the domestic output is insufficient to meet demand, value-added fish products are routinely supplied to the region, mostly from India, China, Thailand, and Norway (Nishanthan et al., 2018). Whereas the value-added fish product-based cottage industry performs an important function in the livelihood development of the seaside fisheries neighborhood and the nutrition protection of the Sri Lankan folks, no empirical study has been conducted in Sri Lanka to discover its current socioeconomic condition or challenges using a holistic approach. The industry's influence on society, the economy, and the environment is not examined, and concerns are not tackled. Nonetheless, the government and other associated organizations are taking steps to grow the business and provide assistance. Lack of research and study in the discussion area, as well as continual criticisms from stakeholders such as nearby communities and the producers themselves, highlight the need of having a comprehensive understanding of the sector before making judgments. It also means that there is an immediate requirement to draw the awareness of the necessary authorities to the industry, since coastal regions, people, and economies are very susceptible due to different factors such as environmental sensitivity, urban characteristics, and economic possibilities. Furthermore, since more than 80% of data utilized by decision-makers is linked to spatial characteristics (Synek and Klimánek, 2014), the use of spatial analysis tools such as GIS enables them to produce a more effective decision with records while eliminating the ambiguities associated with statistical and traditional decision-making approaches. As a result, it is important to focus decision-makers emphasis on using more industry-specific decision-making processes. The present study aims to carry out a GIS-based vulnerability assessment of the Kudawella fish drying cottage industry by recognizing the socioeconomic, environmental, and industry-related contexts of existing producers and the industry, difficulties confronted by producers, and vulnerable locations in the village using geospatial analysis.

The key terms; cottage industry, challenges faced by cottage industry and vulnerability and vulnerability mapping are explored by using existing literature to direct the current study.

1.1 Cottage Industry

Securing a source of income has always had an impact on people's health, their children's education, and their whole way of life. Cottage industries are an example of a way of life that has existed since the dawn of time. It is necessary to identify 'Cottage Industries,' which have played a significant part in our country's economy. Village businesses, agro-industries, rural industries, and informal industries are all terms that have been used to describe cottage industries. The industrial strategies' wide categorization and recognition criteria are ambiguous and frequently perplexing when it comes to small-scale industries (Tasneem and Biswas, 2014). A cottage industry is run entirely or mostly with the support of family members, as a full-time or part-time vocation. Regrettably, there is no universally accepted definition of cottage businesses. Depending on the thing in question, these have been described variously. According to Hasan et al. (2017), cottage businesses employ a fairly small number of people and require a little quantity of capital. In certain cases, the owner is also the lone worker. Even when outside labor is engaged, the owner has a significant amount of responsibility for donating his time and effort. According to Rahman & Srivastava, (2018) in a cottage business, the house provides the workplace. Although some people believe the cottage industry to be their only form of income, several producers work part-time. The adoption of artisanal methods is a significant aspect of cottage industry operations, according to Bangladesh Small and Cottage Industries Corporation (BSCIC) (Rahman and Kumar, 2018). When it comes to cottage industries, manufacturers rely on family customs passed down through the generations. As a result, technology utilization is either non-existent or extremely limited. Small-scale and cottage businesses, according to Hasan et al., (2017), can be founded without formal authorization. Aside from that, there is evidence of the utilization of local raw resources and their consumption within the nation (domestic usage). The use of local raw resources gives the sector a competitive edge in terms of location.

The majority of manufacturing procedures are done using artisanal methods. As a result, there is a line drawn between cultural values in these businesses. Furthermore, these industries give an excellent opportunity for women entrepreneurs and other underserved groups in society to demonstrate their entrepreneurial and inventive abilities (Chutia, 2019). Most low-income households rely on the cottage industry to supplement their income. As a result, these people have the opportunity to generate money through cottage enterprises, a fair and equal distribution of national revenue is possible. Cottage businesses may be found in different types of settings, including urban, semi-urban, and rural. However, rural cottage industries are the ones that have received a lot of attention in the literature (Islam, 1993;

Tasneem and Biswas, 2014). Cottage industries, on the other hand, lay the way for infrastructural development, economic development, and social development, allowing rural areas to experience growth that can be witnessed across the country. As previously stated, raw materials for these businesses are obtained from the surrounding area. In addition, the labor is provided by local jobless people. As a result, cottage businesses make use of underused or non-utilized resources. Although Lumna & Banu, (2019) claim that significant returns may be obtained with little investment, this is not the case in every cottage enterprise. The degree of return varies depending on the kind, nature, and size of the industry's difficulties. However, in general, the amount of money invested is little. Because of considerations such as resource distribution and market availability, the majority of cottage businesses are clustered together. These agglomerations influence infrastructure expansion, market opportunities, and resource-sharing incentives. According to Rupasena, (2014) the need to manage living expenditures, family difficulties, dignity concerns, and the desire to employ formal training or experiences obtained can all be considered motivations for entering businesses. However, there may be other factors at play, which vary based on the business and the psychological makeup of the makers.

1.2 Challenges Faced by Cottage Industry

Cottage businesses have a variety of socioeconomic, economic, and environmental consequences. They might be either beneficial or detrimental. According to Ajayi (2004), cottage businesses lead to environmental degradation, although academics have given less focus to them than to SMEs. Furthermore, the use of artisanal methods causes physical discomfort for employees, such as musculoskeletal disorders (Kumar et al., 2014). The majority of these challenges arise as a result of intrinsic limits in small-scale industries. Such limits are defined as industry challenges. According to Raof et al. (2020), four major problems have been identified in SMEs in cottage industries in Kota Bharu, including human resource growth challenges, a lack of operational management, a lack of financial resources, and a lack of market power. Hence, four significant issues in the food processing industries in Ahmednagar district, India have been identified: production challenges, financial challenges, human resource challenges, and marketing challenges (Ramchandra, 2019). Three key problems were highlighted in the Sezhiyan and Gnanadeiveegam, (2020) investigations of cottage industries in Vilianur, Puducherry: political administration, financial limits, and occupational constraints. Marketing limits, financial concerns, difficulty with raw materials, transportation problems, and power shortages have all been cited as important challenges in studies of small and cottage enterprises in Uttar Pradesh (Pandey, 2013). According to Rahman and Kumar (2018), several challenges have been listed in cottage industries in Bangladesh's Khulna division, including a lack of working capital; high raw material costs; a lack of organizing capability; insufficient technology; inefficiency; a lack of policy support; a large knowledge gap; a lack of power supply; a lack of credit facilities; infrastructural problems; insufficient government support; a lack of government support; return from product.

1.3 Vulnerability and Vulnerability Mapping

Vulnerability of cottage industries may be defined as the capacity to withstand external pressures such as environmental risks, social concerns, and economic threats that have a detrimental impact on the industry's well-being (Ribot, 1996). Vulnerability mapping and geospatial analysis may be employed to discover vulnerable regions because most of these characteristics have spatial dimensions (Shen, 2000). For this type of study, a Geographic Information System (GIS) can be employed, which is defined as "a computer system for recording, storing, querying, analyzing, and presenting geographic data" (Murseli and Isufi, 2014). The data that is geo-referenced and processed in a way that allows a decision-maker to make decisions is the information employed in GIS. According to King and Kiremidjian, (1994) GIS is a risk assessment tool that decreases ambiguity and the utilization of less realistic assumptions in statistical risk assessment methodologies. Coastal vulnerability evaluations are well-known in GIS-based vulnerability assessments. Jana and Hegde, (2016) assessed the vulnerability of Karnataka's coastline line, Mohamed, (2020) used multi-criteria analysis to study the Nile Delta, and natural catastrophes or phenomena-related vulnerability evaluations are widespread in global and local GIS literature. Wijesundara, (2014) researched the Tsunami tragedy in Sri Lanka. However, planning-related research contains literature on vulnerability or risk evaluation of human-induced behaviors. Hence, Inanloo, et al., (2016) is one instance of a study that looked into the vulnerability of Miami's transport systems. Making decisions is a difficult process. If numerous criteria are used in the decision-making process, the decision-maker must examine all of them to make an effective conclusion that achieves the end goals (Synek & Klimánek, 2014). The weighted overlay analysis is a decision-making method that is mostly used to assess “suitability” (Jafari and Zaredar, 2010). When measuring the "vulnerability, resilience, and capacity of reaction of a territorial system to distinct threats," all important social, economic, cultural, and political variables must be taken into account (Erdogan and Terzi, 2022). This study emphasizes that such assessments are "site-dependent," meaning the necessity to use additional location and incident-specific parameters when assessing using GIS (McMaster et al., 1997). Accordingly, the current study aims to perform a GIS-based vulnerability analysis for the fish drying cottage industry by using geospatial analysis to describe the socioeconomic, environmental, and industry-related influences of operating producers and the industry, obstacles confronted by suppliers, and vulnerable places in the village

2. Methodology

2.1 Description of Study Area

Kudawella (shown in Figure 1) is a fishing community on Sri Lanka's southern coast. It is part of the Hambantota district and is close to the Matara district line. Tangalle Pradeshiya Sabha is the local authority to which it belongs. Hence, Kudawella has five Grama Niladhari Divisions: Kudawella East, Kudawella West, Kudawella North, Kudawella Central, and Kudawella South. The

village has a total land area of 1.87km^2. Coastal vegetation may be observed along the coastal belt, and there is mangrove cover near the Mawella Lagoon. The landscape of Kudawella is very flat. The altitudes vary between 0 and 45 meters. The overall population of the region is 4854 people, with 1495 families. Fishing is the major source of income for the inhabitants, and 1317 households are involved in the industry.

Figure 1 Case study area (Survey Data, 2021)

2.2 Data Collection and Analysis

The data is collected via primary and secondary data sources. Past studies are scarce and the business is dynamic. Therefore, primary data is required to establish the industry's and manufacturers' current socioeconomic and industry-related backgrounds. Thus, primary data is used to identify industrial difficulties. The physical extent of the research region is limited, current secondary data is insufficient for geo-spatial analysis. A guided structured questionnaire survey done by a researcher recognized 381 businesses as of November 2021, and descriptive analysis was undertaken on the data received. A content analysis of qualitative data collected from a judgemental sample of 10 businesses through semi-structured interviews and two villagers, one labourer, and two government officers active in the field through unstructured interviews indicated the limits. In addition, observations and images are used as primary data in the study. The relative locations of the cottages were also calculated using OpenStreetMap, and the absolute coordinates of a sample of 27 cottages were acquired using GPS. However, a literature analysis is conducted first to identify and describe essential ideas and theoretical facts connected to the study using secondary data sources. Accordingly, secondary data is gathered through maps created by government agencies, documents, papers, and websites of government agencies, as well as journals, articles, and periodical publications.

Conversely using data from OpenStreetMap, GPS, and supplementary data sources, the weighted overlay analysis was performed in ArcMap 10.8 to build a vulnerability index map. Data layers including population density, selection for government development projects, and elevation were transformed into raster format before reclassifying. The Euclidean distances of other discrete data layers were used to reclassify them. The reference layer for the raster transformation is GN Divisions of Kudawella, which was derived from the shape file of GN Divisions of Hambantota created by the Sri Lanka Survey Department. All additional data layers were collected from OpenStreetMap and confirmed in Google Earth Pro using KML layers. Figure 2 depicts the progressive methodological framework.

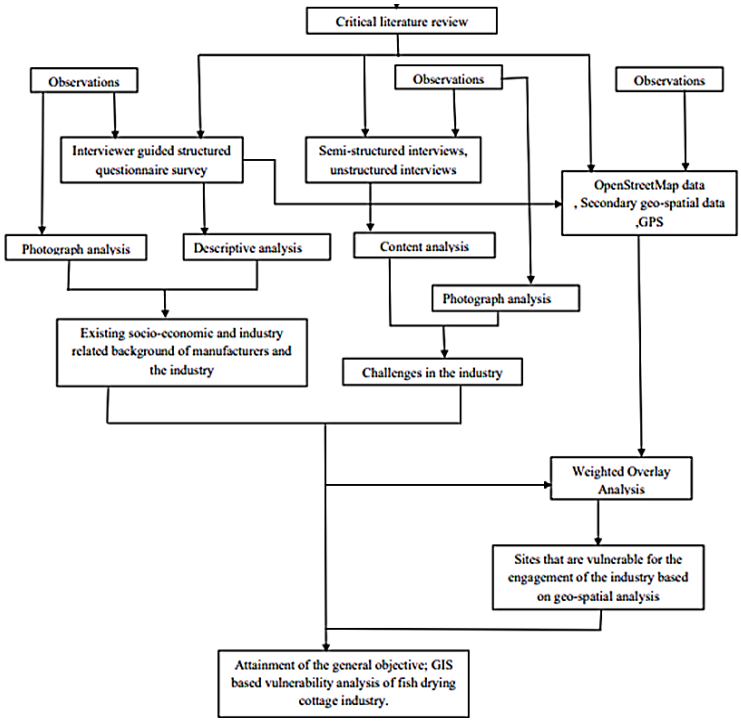


Figure 2 Stepwise methodological framework

3 Result and Discussion

3.1 Questionnaire Analysis

According to descriptive statistics, Kudawella-South has the largest percentage of factories since it is the nearest to the primary raw fish purchasing site, the Kudawella fisheries harbor. Kudawella-East has a smaller percentage of manufacturers than the rest of the hamlet due to its higher elevation and more difficult roadways. As a result, even if the GND is geographically closer to the harbor, transportation has become problematic. This demonstrates the industry's reliance on transportation. People have avoided the sector because they have susceptible age groups in their families, such as children. The majority of the elderly view the business to be a burden on children's education since it requires a lot of effort and manpower. Children are therefore preoccupied. According to the observations, households with elderly parents either shun the industry or employ a large number of outside personnel. The community has the opportunity to implement technology and advances due to its high literacy rate,

Fisheries have a close relationship with the industry since most of the shares acquired as the fisherman's share of the capture is used in the industry. In addition, most multiday-craft owners employ the industry catch if it appears that they will not be able to acquire a decent wholesale price at the auction.

According to Rahman and Kumar (2018), the dwelling provides the workplace in a cottage business. A residential parcel of land is regularly observed in the community in the fish drying cottage business of the study region. Almost half of the area used for industry (48.03 percent) is in the 11 to 15 perch range. Although the acreage necessary for this business is more than that required for residential usage, individuals are used to using their rooftops, surrounding roads, the seashore, and empty lands of others to engage in the activity. According to observations, most lenders are hesitant to rent out their property to the business since excavations and refilling are required at the end of the time. Furthermore, businesses that do not participate in the sector typically do not contemplate leasing since income creation in the business is unpredictable most of the time. Since the majority of the businesses lack mobility, new job possibilities are established for vehicle owners both inside and beyond the town. The amount of raw fish acquired, weather circumstances, labour engagement, technological involvement, market trends, and personal affairs of the manufacturers all influence how frequently they engage in the sector every month. Multiple spins in tiny numbers, on the other hand, deprive producers of internal economies of scale. Furthermore, the absence of a proper market may be noted. In addition, infrastructure conditions and labor satisfaction are also low. Only four producers have registered their businesses. Most notably, artisanal practices are employed to engage in the sector.

3.2 Challenges in the Industry

According to table 1, key challenges include laborer discontent, labor insufficiency, a lack of formal funding sources and mechanisms, unawareness, a lack of external assistance, unforeseen market and climatic circumstances, a lack of an industry for selling, political favoritism and initiatives, government policy decisions, and a lack of institutional decision-making organization.

Table 1 Identified challenges in the industry

Challenge Category	Challenges
Manufacturing challenges	• Price escalations of raw fish • Lack of concern for icing raw fish • Non-usage of containers for transporting raw fish • Unavailability of a formal and environment-friendly mechanism for disposal of solid residue • Lack of awareness on decisions made by authoritative bodies • Unexpected weather conditions • Inadequacy of physical infrastructure • Neighbor opposition • Lack of concern to gain knowledge and technology about preservation and storage
Financial challenges	• Usage of informal credit and informal pawning services which have high-interest rates • Reluctancy of banks and financial institutions for providing loans • Working capital deficiency
Labor-related challenges	• Scarcity of labor • Labor dissatisfaction because of the unavailability of, a fair payment determination method sanitary facility • Lack of concern and awareness on health
Selling related challenges	• Unavailability of a proper and common price determination mechanism for products • Perception of the retail buyers on the quality of the products
Political and legal challenges	• Influences on the determination of raw fish price • Political favoritism in giving aids • Central government policies on imports of dried and Maldive fish
Institutional challenges	• Unavailability of a long-term plan for education and training and constant supervision • Non- prevalence of informed and integrated decision making among institutions
Other challenges	• Visitor unrest • Personal misconceptions and misbeliefs of the manufacturers

3.3 Vulnerability Analysis

Since the mentioned difficulties produce risk in the sector, nine criteria were used to construct a vulnerability map. As mentioned earlier, vulnerability makes the cottage industry susceptible to external pressures. In other words, external pressures influence negatively and make the industry susceptible. So, the factors which influence negatively the well-being of the industry are recognized to define vulnerability. As a consequence of observations and literature, this section of the analysis has identified several criteria that define vulnerability. According to

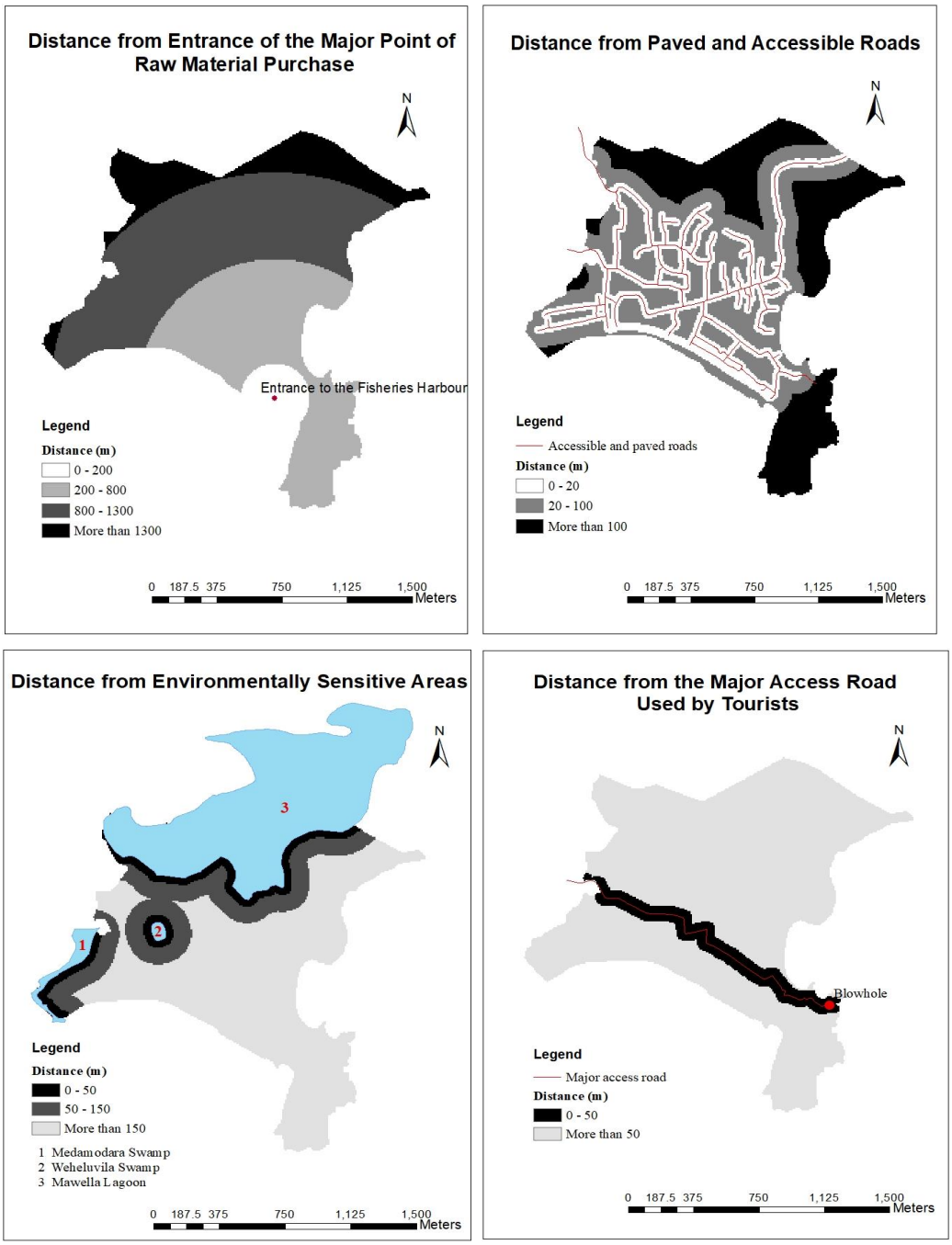
the literature evaluation, incident-specific micro and macro data should be employed for the analysis. Table 2 shows the criteria for determining site vulnerability, the layer name in Arc Map 10.8 analysis, the weight for their relative level of relevance, and the vulnerability scores for each factor.

Table 2 Description of criteria, weights, values, and vulnerability scores

Criteria	Layer name	Weight	Values	Vulnerability Scores
Distance from the harbor (the major purchase point)	Reclass_MP	10%	Distance from the entrance of the harbor (market area) in meters	
			0-200	0
			200- 800	1
			800-1300	2
			1300-1700	3
			1700-2100	5
			2100-2500	6
			2500-2900	8
			Above 3000	9
Distance from a paved and accessible way	Reclass_roads	10%	Distance from paved and accessible roads in meters	
			0-20	
			20-100	0
			More than 100	5
				9
Distance from environmentally sensitive areas	Reclass_MESA	15%	Distances from the environmentally sensitive areas (m)	
			0-50	9
			50-150	3
			More than 150	0
Distance from the major access road used by tourists	Reclass_MARUT	10%	Distance from the major access road used by tourists (m)	
			0-50	9
			More than 50	0
Distance from the coast	Reclass_Coast	15%	Distance from the coast (m)	
			0 - 35	9
			More than 35	0
Location within the Tsunami warning zone	Reclass_Tsunam	5%	Tsunami setback consideration (m)	
			0-100	9
			More than 100	0
Population density	Reclass_GND	15%	Population Density/km^2	
			0-660	0
			661-1320	1
			1321-1980	2
			1981-2640	3
			2641-3300	4
			3301-3960	5
			3961-4620	6
			4621-5280	7
			5281-5940	8
			Above 5941	9
Selection for government projects	Reclass_Nishpadanagam	8%	The status of selection for the project	
			Selected	0
			Not selected	9
Distance from social institutions	Reclass_Social	12%	Distance from the social institution (m)	
			0-50	9
			50-100	8
			100-250	7
			250-500	6
			More than 500	0

According to table 2, the greatest influence on susceptibility is the distance from ecologically sensitive regions, population density, distance from the shore, and distance from social institutions. It is primarily because most authority organizations' judgments ignore

the industry's environmental and social dimensions. As a result, there is an immediate need to include those two factors. Hence, Major environmentally vulnerable sites were recognized as Mawella lagoon, Veheluvila marsh, and Medamodara Swamps. People are significantly more influenced by the smoke and odor produced by industry when population density is high. Also, when population density is high, individuals have a lot of legal authority to oppose the industry. As a result, high population density exposes the sector to risks. Sites in the setback zone are deemed especially susceptible due to their proximity to the shore. Transportation parameters are prioritized next, as transportation expenditures create major costs and efforts. Furthermore, it is predicted that government initiatives would reduce a large number of industrial obstacles, such as marketing challenges. As a result, non-selection for government initiatives is regarded as risky. According to the observations and perspectives of industry officials, there is the possibility to expand tourism and the industry at the same time. As a result, distance from main tourist access highways is weighted on a low scale in terms of vulnerability. Location inside the Tsunami warning has received the lowest grade since it is not a common factor. Hence, as the sector accumulates a substantial quantity of people and resources, attention is directed to natural occurrences that generate dangerous circumstances. Figure 2 depicts the weighted and classed criterion maps.



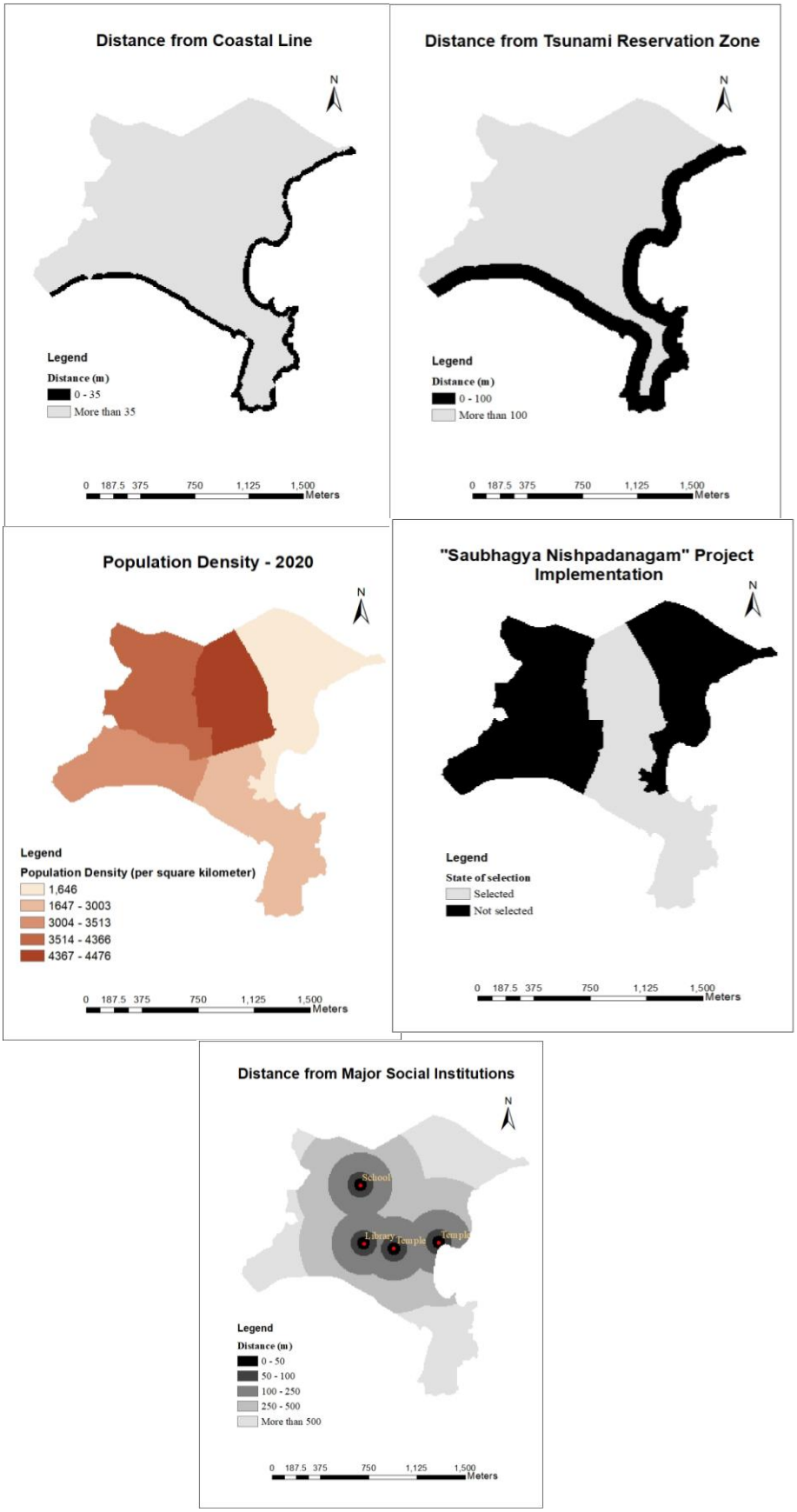


Figure 2 Criteria map

The Model Builder feature of Arc Map 10.8 was used to create and apply the multi-criteria analysis on the classed maps. Figure 3 depicts the developed model.

Figure 3 Model used in ArcGIS for the Weighted Overlay Analysis

According to the weighted overlay study, the majority of businesses (65.62 percent) are in the intermediate vulnerability zone. There are 250 of them. The zone covers 1.2072 km^2, accounting for 58.52 percent of the village's total land area. Figure 4 depicts the Kudawella vulnerability index map based on the parameters listed in table 2. Table 3 depicts the geographical area and percentage of a number of businesses in each vulnerability category.

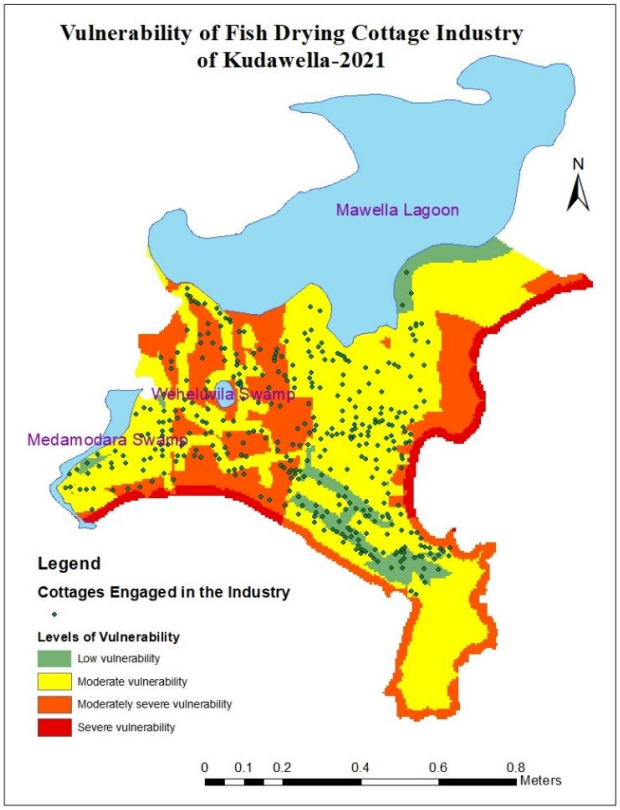


Figure 4 Vulnerability index map

Table 3 Percentage of land extents and percentage of manufacturers by vulnerability level

Level of vulnerability	Percentage of land extent	Percentage of manufacturers
Low vulnerability	7.64%	13.91%
Moderate vulnerability	58.52%	65.62%
Moderately severe vulnerability	29.72%	20.47%
Severe vulnerability	4.12%	0%

According to the final study, no manufacturer was in the highly susceptible zones between August and November 2021. The extremely vulnerable area lies along the coastal belt, and it displays vulnerability to environmental and transportation problems. Low susceptibility areas are primarily defined by the impacts of distance from social institutions, distance from accessible routes, population density, distance from the coastal line, and distance from the tsunami protection area. The low susceptible locations had the lowest proportion of manufacturers that existed throughout the studied period. All of these regions, though, are vulnerable in some way. As a result, depending on the criterion used, no location may be considered non-vulnerable.

4. Conclusion

Sri Lanka's coastal regions are appealing urban centers that offer a variety of commercial activities. Fisheries are a popular economic activity in coastal locations due to their closeness and availability of resources. Fisheries generate direct and indirect revenue for coastal towns, and these economic activities are strengthened if a fishing port is located closer. Tangalle has the highest fish production in the country, and it is no surprise that Kudawella contributes significantly to that total. Along with fishing, fish drying has long been a cottage business in Kudawella. However, in recent times, fish drying has grown as a commercial and large-scale cottage business, attracting an increasing number of producers. The business has provided direct and indirect job possibilities for locals while also efficiently preserving the excess production of multi-day crafts. However, the industry's environmental and social problems frequently cause a public uproar. However, it appears that government institutions do not consider social and environmental issues while making decisions. Furthermore, the industry's politically fascinating character has facilitated its fast development isolating and making some manufacturers vulnerable. The research was carried out primarily to enlighten key authorities, institutions, and stakeholders on the need to analyse the sector and adopt decisions to attain sustainability in the industry.

The study's main intention was to identify the manufacturers' and industry's socioeconomic and industry-related backgrounds, obstacles, and a GIS-based vulnerability index for the industry to meet the study's overall purpose of GIS-based vulnerability analysis of the fish drying cottage industry. The field survey found 381 manufacturers between August and November 2021. According to the descriptive study, the availability of modes of transportation, as well as the convenience of transportation, are critical to the sector. People have shied away from the sector because they have vulnerable age groups in their families, such as children. Due to its high literacy rate, the community also can introduce technology and advance. Fisheries have a strong link to industry and also own a portion of residential property. Additionally, the lack of a proper market may be noted. In addition, infrastructure facilities and labourer satisfaction are also low. It is also possible that less concern is devoted to business registration. Most crucially, the industry is run using artisanal methods. Buying raw fish, bringing it to the site, gutting and scaling it, boiling, removing vertebrae, smoking, drying in the sun, coating ash, and storing it for sale are all laborious phases in the method. Uncertainty; lack of external assistance; unpredictable market and environmental factors; absence of a selling market; political favoritism and interventions; policy decisions; and lack of organisation of institutional decision-making were highlighted as some of the industry's key challenges. Furthermore, the ambiguous nature of obstacles such as manufacturing, finance, labor-related, sales-related, political, legal, institutional, and other challenges would make it difficult for key authority entities to determine their responsibilities in resolving industry issues.

The study classified vulnerability into four thresholds: low vulnerability, moderate vulnerability, relatively severe vulnerability, and severe vulnerability. The level of severe vulnerability necessitates quick action by authority entities. For businesses located in the very susceptible region, either removal from those places, a high degree of monitoring, a large quantity of help, or the installation of restrictions will be required. Manufacturers in moderately sensitive locations will require less care than those in extremely vulnerable ones. However, ongoing oversight, assistance, and regulatory implementation are required. Moderately fragile places require less assistance than extremely vulnerable areas. However, monitoring will be required in this area as well. Low vulnerability zones may be empowered and concerns gradually eliminated. Based on the criteria involved, no manufacturer has been in the highly susceptible category; yet, the industry need assistance, oversight, awareness, and long-term planning. Furthermore, the authoritative organizations have the authority to assess the degree of "capital aid, technical know-how, and trade ties (Rupasena, 2014)." By taking into account the level of vulnerability, "awareness on financial schemes, counseling and guidance, efficient law to facilitate the industry" (Sezhiyan & Gnanadeiveegam, 2020), "processing technology, quality raw materials" (Teixeira, 2018), and "local branding" (Kurokawa, 2013) in association with tourism. Therefore, the vulnerability index map displays the speed with which judgments are made as well as the diversity of decisions. However, because the sector is dynamic, consistent and specified research projects are required. In addition, to arrive at challenge-specific conclusions, more criteria should be integrated into future GIS-based vulnerability analyses.

Acknowledgments

The authors sincerely acknowledge the Center for Real Estate (CRES) of the Department of Estate Management and Valuation, University of Sri Jayewardenepura, Sri Lanka.

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IJBES

International Journal of Built Environment and Sustainability
Published by Penerbit UTM Press, Universiti Teknologi Malaysia
IJBES 10(1)/2023, 73-85

Evaluation of Thermal Admittance of Compressed Earth Bricks C.E.B Configurations for School Buildings in Hot-dry climate region of North-western Nigeria

Sanusi Sani Maimagani
Department of Architectural Technology, Waziri Umaru Federal Polytechnic Birnin Kebbi, Nigeria

Roshida Abdul Majid and Leng Pau Chung
Faculty of the Built Environment and Surveying, Universiti Teknologi Malaysia. 81310 UTM Johor Bahru, Johor, Malaysia

ABSTRACT

Permeation of heat into the school building enclosure through external walls components of the building resulting into the numerous consequences which causes unhealthy indoor living conditions for teaching and learning activities, which has a negative impacts on the students general academic performance and their productivity, the study carried out a fieldwork experimentation where four experimental models (chambers) were built using four dissimilar compressed earth (C.E.B) configurations; compressed earth horizontal hollow brick (C.E.H.H.B), compressed earth vertical hollow brick (C.E.V.H.B), compressed earth cellular brick (C.E.C.B), and compressed earth solid brick (C.E.S.B) respectively, data were collected from fieldwork experimental chambers using two distinct wall surface temperature measuring devices; an onset UX120-M600 4-channel analogue data logger and Testo 835 Infrared thermometer which were utilized to measure the interior wall surface temperature facing the west direction of each experimental chamber to determine the rate of thermal admittance of the entire chambers built with distinct C.E.B configurations, the extracted data using surface temperature measuring instrument were analyzed using the spss software package for identification of the C.E.B configurations with the least thermal permeation from outdoor environment to indoor space of the school building via external walls of the building. After the statistical analysis, the study's outcome revealed that compressed earth horizontal hollow brick (C.E.H.H.B) has a minimum heat transfer rate of (34.933^{OC}) and (35.7493^{OC}), among other C.E.B configurations. This undoubtedly indicated the appropriate C.E.B configurations for school buildings in hot-dry climate regions of northwestern Nigeria.

Article History

Received : *29 September 2022*
Received in revised form: *06 December 2022*
Accepted : *08 December 2022*
Published Online : *31 December 2022*

Keywords:

Compressed Earth Brick (C.E.B) Configurations, Wall Building Envelope, thermal Admittance, Thermal Performance, thermal properties, hollow block/Block cavity, School Building.

Corresponding Author Contact:
maimagani@graduate.utm.my

DOI: 10.11113/ijbes.v10.n1.1069

1. Introduction

Compressed earth bricks are made from earth, a naturally abundant and non-exhaustible material due to its replenishing characteristics. It is manufactured using a manual moulding machine or an automatic hydraulic machine, and there are several types of C.E.B, distinguished by their mixing processes or final product finishes: sun-dried C.E.B, backed C.E.B, and C.E.B with cement stabilizers for added strength, either sundried or backed (Maimagani et al., 2022).

Compressed Earth Brick (C.E.B) is the predominant material for buildings construction regardless of its typologies in all parts of

the climatic regions of Nigeria before the foreign incursion into the west coast of Africa (Adeniyi et al., 2019). Discoveries of advanced building materials such as concrete masonry units, also called sandcrete hollow blocks. However, it replaced the Compressed Earth Brick (C.E.B.), considered an energy-efficient, environmentally-friendly building material. Compressed Earth Brick (C.E.B) is regaining its lost acceptance in the building industry due to its exceptional sustainable characteristics (Akhter and Sarker, 2018).

Compressed Earth Brick (C.E.B.) is acknowledged to have a high thermal performance. However, the study is craving to explore more options C.E.B configurations to further determine a more improved C.E.B configuration in term of thermal performance to achieve a more sustainable walling material that will enhance school building indoor living condition, student wellbeing and energy saving for cooling for the attainment of comfortable school building interiors. The study proposed four distinct varieties C.E.B configurations as in indicate in figure 1. Compressed earth horizontal hollow brick (C.E.H.H.B), compressed earth vertical hollow brick (C.E.V.H.B), compressed earth cellular brick (C.E.C.B), and compressed earth solid brick (C.E.S.B) respectively.

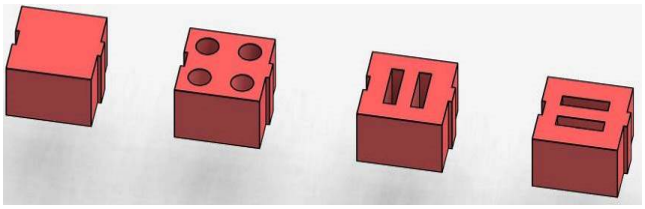

Figure 1. Compressed earth brick (C.E.B) configuration

Traditional brick walls remain an appropriate construction material for construction of low and medium rise buildings, providing weather protection, fire, and sound insulation, flexible to achieve any desired form, shape, and it requires minimal maintenance for long period (Sassine et al., 2017). The solar heat transfer in buildings depends on the building materials used. The dimension, sizes, the cavities options of blocks are also characterized with distinct thermal properties and play a crucial role in the heat permeation between outdoor and indoor environment (S.O. Adepo et al., 2020).

Earth is an old building material widely used in extreme hot-dry desert countries with a tremendous advantage in thermophysical properties over conventional building material such as sandcrete hollow block also called concrete masonry unit (Al-Ajmi et al., 2016). Earth is an environmentally friendly building material that improves the comfort of a building's interior without using an artificial cooling system. Earth also has a huge potential to lessen the negative effects of greenhouse gas emissions from the building sector, which are a current global concern. (Papayianni and Pachta, 2017; Maimagani et al., 2021).
Earth brick as a building material for construction is considered to be sustainable building material due to its affordability, environmental friendliness, and energy-efficient building materials (Maimagani et al., 2021; Sutcu et al., 2014; Arrigoni et al., 2017; Stone et al., 2014; Pandey and Bajracharya, 2017; Onyegiri and Ugochukwu, 2019). Earth as a building material has been used for building construction since the ancient period, mostly in developing countries. Concrete, concrete blocks supplanted the materials, and cement which is not as sustainable as earthen materials economically and environmentally, and it is in abundance and low cost in production (Fernandes et al., 2019; Costa et al., 2019; Muazu, 2017; Teixeira et al., 2020; Doc et al., 2017; Pica, 2018; Hegediš et al., 2019).

Adopting a sustainable building strategy will lead to attainment comfortable indoor environment, which increases occupant productivity and healthy indoor living conditions. These include appropriate building materials selection, building orientation, indoor spaces configuration, and construction methods (Musa and Abdullahi, 2018; Napier, 2015; Mydin and 1, 2017; Ochedi and Taki, 2019).

Building envelope composed of several components of the building such as the foundation, walls, roof, windows, shading devices, and fenestration. However, these parts of the building components serve as a barrier of the indoors space of the building from the outside environment. Moreover, walls are opaque parts of a building that make up a significant part of the building envelope, which greater parts of its surface area are exposed to the harsh external weather conditions (Hamimi et al., 2016; Udawattha and Halwatura, 2017; Maimagani et al., 2019; Jannat et al., 2020).

Thermal admittance is the ability of a material to exchange heat with its surroundings environment when the weather changes. The rate of thermal admittance is based on density, thermal capacity, and thermal conductivity of the material. It has also been affected by changes in temperature and the resistance of the air at the surface. Furthermore, the thermal admittance of a building material is measured by its U-value. The higher the U-value, the better the material is at transferring heat from the outdoor environment to the indoor environment. The lower the U-value, the better the material is at averting heat transfer inside the building interiors (Shaik and Talanki Puttaranga Setty, 2016).

Thermal performance in buildings involves selecting energy-efficient building materials to minimize overreliance on artificial means to achieve comfortable building interiors, increase occupant wellbeing and productivity, and reduce lifecycle costs while optimizing energy savings (Gorse et al., 2016; Mirrahimi et al., 2016; Kwag, Adamu, and Krarti, 2018).
The thermal performance of the building can be enhanced by curtailing the heat transfer via the external walls building envelopes. Furthermore, the wall component of the building forms the greater part of the entire building, which regulates the fluctuations of the external weather conditions of the outdoor environment and serves as a third layer of the human skin for maintaining a stable body temperature (Mirrahimi et al., 2016; Kočí et al., 2019; Jannat et al., 2020). The author further elucidated that thermal properties of the building materials have a greater impact on the comfortable building interiors conditions to

the building occupants. Thermophysical properties of building material determine the indoor air temperature and cooling demand, with or without the employing the artificial means (Jannat et al., 2020).

The thermal properties of the building materials determine the rate of heat permeation into the building enclosed spaces from the external environment, and in turn, has a significant influence on a comfortable indoor area of the building, earth brick has high thermal resistance properties, and it is the preferable walling material especially for external wall to prevent heat infiltrations into the building interiors (Tammy et al., 2017). A suitable selection of exterior wall materials will reduce the rate of heat transfer from the exterior environment to the interior spaces of the building, thereby reducing the need for mechanical systems to attain comfortable building indoors (D Wang, W Yu, X Zhao, 2018). The heat transfer in buildings is determined by the thermal characteristics of the enveloping materials (Adepo et al., 2020). Wall components with exceptional thermal properties reduce the need for artificial cooling, hence reducing the cooling load and environmental effect of the building (Odunfa et al., 2018).

Construction of building with blocks with hollows, cores, voids or cavities have many advantages over solid blocks, such as better thermal performance sound and acoustic insulation (Arsenovic et al., 2010; Caruana et al., 2014; Ismaiel et al., 2022). The study reveals that wall building components with a high number of cavities within the block have a low rate of heat transfer from the exterior environment to the interior of the structure (Fogiatto et al., 2016). The size, shape, and number of cavities on a given block play a significant effect in rate of heat transfer from an external wall surface of buildings to the building interior spaces (Adepo et al., 2020; Sassine et al., 2020).

School buildings are among the building typologies that require indoor comfort to enhance students' performance and staff productivity. It's an academic setting where students spend significant time in lecture halls, libraries, studios, and laboratories. Students' performance and comfortable indoor environments has a significant relationship (Khaled M. Dewidar1, 2012; Rider, 2014; Radha and Husein, 2018; Ji, 2019). School buildings are vital spaces with a considerably higher occupancy rate than other buildings, as students spend 25% more time than in any other building. School buildings have a higher level of social responsibility for educational reasons than other buildings. (Kati and Krsti, 2021).

Educational building interiors are anticipated to be comfortable and healthy for living conditions and learning, as it directly relates to the student's well-being and academic performance (Keco, Pont, and Mahdavi, 2019). Sadat, Tahsildoost, and Hafezi (2016) state that thermal discomfort in school buildings can lead to unsatisfactory conditions for students learning activities, thereby creating an unconducive environment for teaching and learning which in turn negatively affect their rate of assimilation and level comprehension. The school building is vital since it serves as a learning environment where students spend considerable time studying in academic learning spaces. The school building is an enclosed space where quality scholars, professional researchers, and future educators are trained to assume future responsibilities in our ever-changing world (Alwetaishi et al. 2018).

Discomfort in building interiors becomes a concerning issue in the built environment as it significantly negatively affects the building occupants' emotions, health, general performance and productivity. However, the comfortable indoor space of the buildings plays a vital role in its occupants' physiological comfort and psychological responses (Haruna et al., 2014). Comfortable building interiors have a significant influence on psychological, physiological balance, performance and productivity, as well as the well-being of the building occupants (Barbhuiya and Barbhuiya, 2013; Geng et al., 2019).

1.1 Description of Study Area

The study area is located in Nigeria, in the north-western region of the countries according to geopolitical zoning. The climate zone is also classified as hot and dry, characterized by high temperatures, very low relative humidity, and little rainfall. 2018's (Maimagani et al., 2022). Moreover, the average temperature of Birnin kebbi is 28.9oC. January is the coolest month, with a mean temperature of 25.1°C. Figure 4 shows that April is the hottest month of the year, with an average temperature of about 33.6 °C. Sokoto state is to the northeast, Zamfara state is to the east, and Niger state is to the south. Kebbi state also shares borders with two other African countries, the Niger Republic to the north and the Benin Republic to the west (Maimagani et al., 2022).

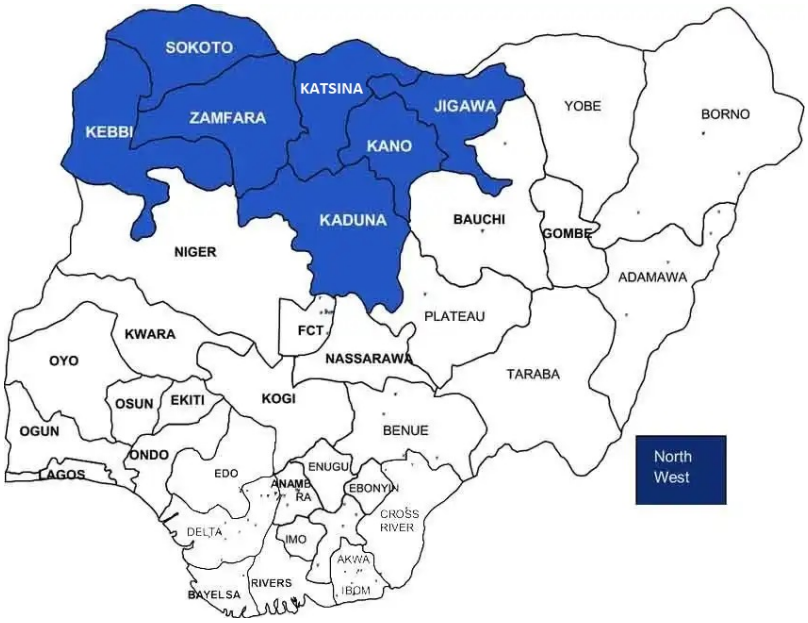

Figure 2. Map of Nigeria indicating North western geopolitical zone (Source: AbdulKadir et al., 2015).

The blue shaded portion of Figure 2 show the states that constitute the Northwestern part of Nigeria. North-western Nigeria is the area of study and it is characterized by intense solar radiation permeating into the building enclosures through building components, especially wall components, because it forms the major part of the entire building. The school buildings in the study area are educational structures where teaching and learning processes occur. There is a need to achieve indoor comfort to enhance academic activities without relying on artificial ways. However, school buildings in tropical regions of north-western Nigeria need to embrace the use of earth as a wall material to achieve a comfortable indoor learning space without much reliance on altricial means.

The north-western part of Nigeria is located in a tropical area of the continent of Africa which is identified with the harsh climatic condition that has negative impacts school buildings due to their exposure to external environment, which in turn has a severe impact on academic learning activities for both students and academic staff. In tropical developing countries with severe temperatures, building envelopes are particularly prone to solar heat gain due to their exposure. As a result, building residents suffer from insomnia, exhaustion, boredom, headaches, and asthma (Akande, 2010; Press and Range, 2018).

In this West African nation such as Nigeria, earth was widely used as the principal building material across all building types. Before the colonial master's inversion, earth was widely employed as a construction material in Nigeria because of its low cost and abundance. The human resources involved are also somewhat low-skilled. In comparison to the sandcrete hollow block or the concrete masonry unit, it is more eco-friendly and uses less energy.

2. Material and Method

2.1 Fieldwork Experiment

Field experiments in this study include the fabrication of C.E. B manual molding machine that produces four types of compressed earth brick (C.E.B) configurations, compressed earth horizontal hollow brick (C.E.H.H.B), compressed earth vertical hollow brick (C.E.V.H.B), compressed earth cellular brick (C.E.C.B), and compressed earth solid brick (C.E.S.B). The moulded bricks of various C.E.B configurations are used as a walling material to construct a small size experimental chamber as shown figure 3.

However, the total number of experimental chambers constructed was four number, C.E.B configurations. Having the same size (1425mm X 1425mm X 2800mm), orientation, headroom, and roofing material, the only differentiating factor is the design pattern of the C.E.B configurations. The four chambers would be subjected to temperature measurement (thermal admittance) using the Onset Hobo datalogger and Testo infrared thermometer.

Figure 3. The four experimental chambers/models

2.2 Method of Data collection

The study employed two distinct wall surface temperature measuring devices for collection of data such as; HOBO 4 -Chanel Analog data logger (UX120-006M), and an infrared thermometer (testo 845) in order to carry out this study efficiently. The two temperature measuring instruments can deliver a reliable result. The sequence of their operations for effective data collection is illustrated schematically in figure 4, and figure 5, respectively.

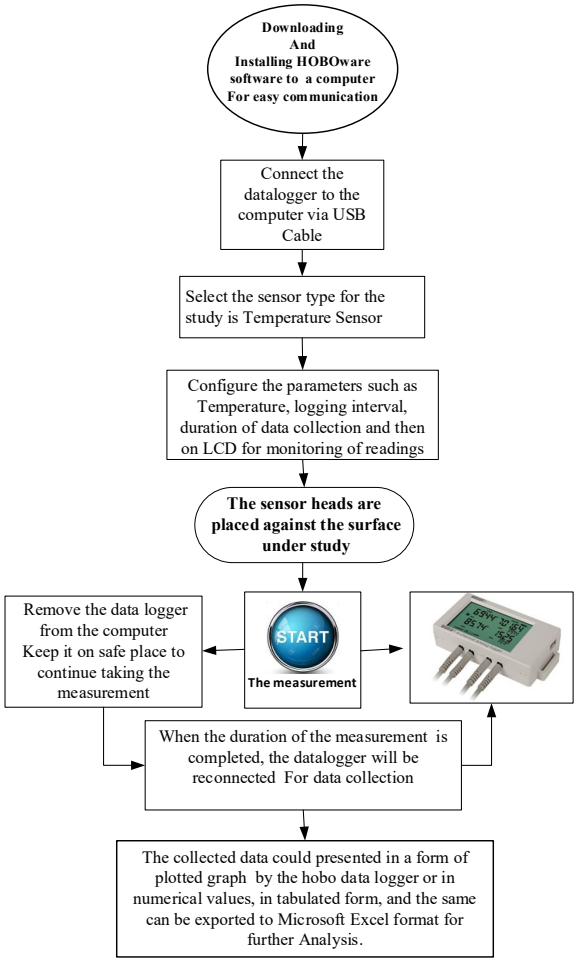

Figure 4. HOBO 4 -Chanel Analog data logger (UX120-006M) sequence of operation.

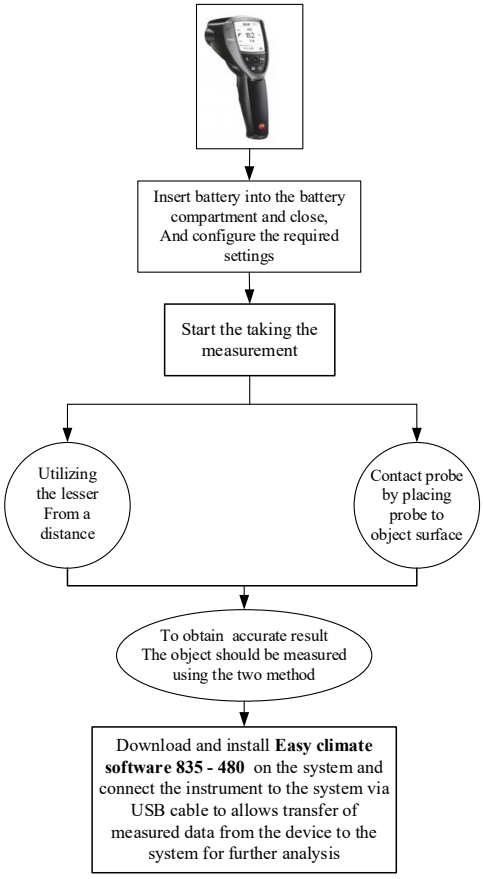

Figure 5. Process of operating the testo 835 infrared thermometer

Additionally, a floor layout for the C.E.B configurations is depicted in figure 6. Figure 7. Shows a cross-section of the experimental chamber and how the hobo data sensor heads are pressed on the interior wall surface to monitor the rate of thermal admittance from the outside to the chamber's interior. Figure 8. illustrates a cross section of a C.E.B configuration experimental chamber or model and demonstrates how infrared data is obtained from the wall surface of a C.E.B configuration.

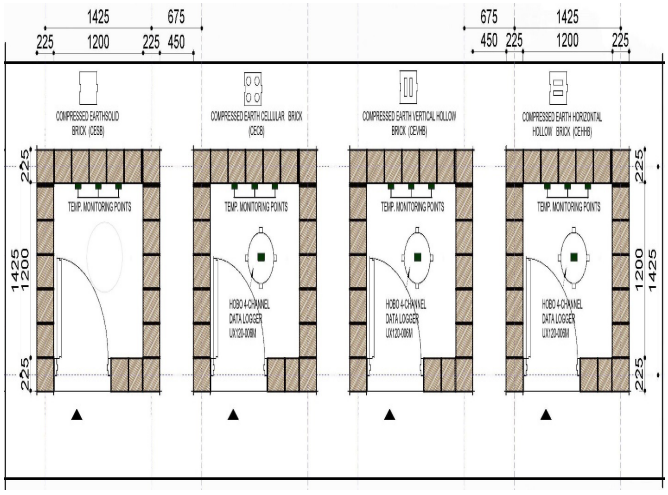

Figure 6. Floor plan of four experimental models (C.E.B) configuration.

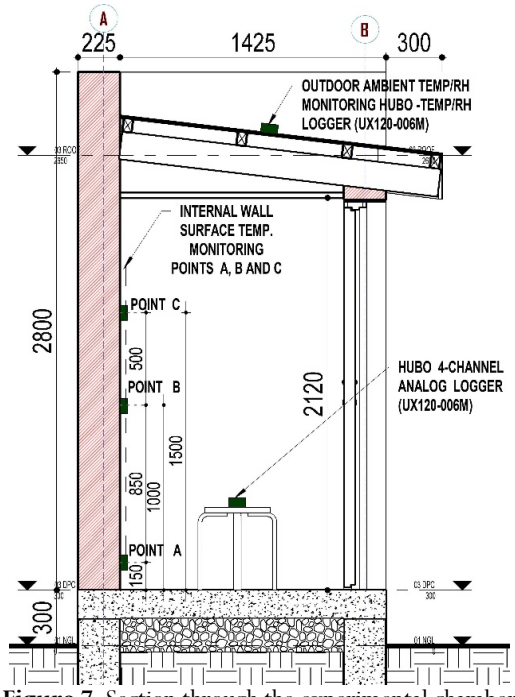

Figure 7. Section through the experimental chamber illustrating the internal surface temperature measuring

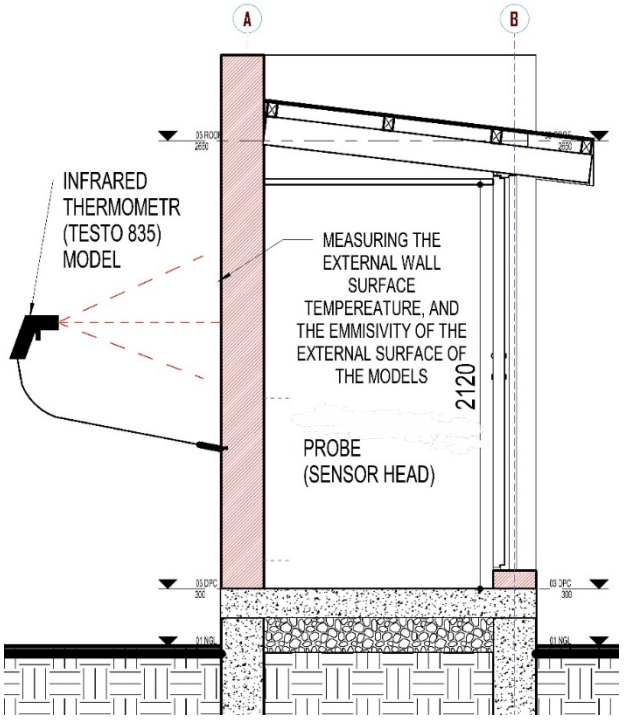

Figure 8. Section indicating the external surface temperature measurement of the model's

2.3 Data Collection

The study employed Hobo data UX120-006M logger analog and testo Infrared thermometer professional temperature measuring instrument for data collection. Each experiment chamber's internal wall surface temperature was recorded, the wall facing the west direction, using the 4 - Chanel Analog data logger UX120-006M temperature sensors placed at three different points. Furthermore, Point A at 150mm, Point B at 1000, and Point C at 1500mm, respectively, as illustrated in Figure 9. These three points represent the human position in different postures in lying, sitting (on the chair or a floor), and standing positions by the universal standard for humans (Leonardo da Vitruvian Man).

However, the 4-channel UX120-006M Hobo data logger data collection for each experimental chamber's wall surface temperature measurement lasted for three months, from March, April, and May 2019. The hottest month of the year in the study area is the month of April. The study intends to cover a month before April and a month after April. The wall surface temperature measurement commenced in March and ended in May. Moreover, the testo infrared thermometer was also used to monitor each chamber's internal wall surface temperature at 6:30 pm when sunset on the 10th, 20th, and 30th of April 2019, as shown in figure 10.

Figure 9. Internal Walls surface temperature measuring points

Figure 10. Testo Infrared thermometer surface temperature monitoring

3.0 Data Analysis

The data collected from the experimental chamber for three months using 4-channel hobo data logger to identify the C.E.B configurations with the least rate of thermal admittance were analyzed using spss software. The analysis outcome for May, April and March 2019 is presented in a tabulated format as indicated in Table 1, Table 2 and Table 3, respectively.

Table 1. Rate of thermal Admittance into the internal wall surface in March 2019

Month	C.E.B. Configuration	Point	Mean	Std. Deviation	Overall Mean	SD
March	CEHHB	A	35.94	3.15	**35.35**	**2.99**
		B	35.54	3.09		
		C	34.57	2.78		
	CEVHB	A	36.24	3.42	35.70	3.20
		B	35.87	3.33		
		C	35.00	2.84		
	CECB	A	35.99	3.25	35.53	3.14
		B	35.79	3.30		
		C	34.79	2.91		
	CESB	A	35.04	3.01	35.67	3.20
		B	35.82	3.27		
		C	36.14	3.35		

The S.P.S.S analysis result presented in table 1 reveals that the compressed earth horizontal hollow brick (C.E.H.H.B.) has the least rate of thermal admittance into the internal wall surface for March 2019, where the overall mean temperature was (**35.35** ^{oc}). Moreover, for April 2019, the result presented in Table 2 also reveals that the compressed earth horizontal hollow brick (C.E.H.H.B.) has the least rate of thermal admittance for overall mean temperature was (35.75 ^{oc}). And finally, Table 3 also presented C.E.H.H.B having least thermal admittance (35.26 ^{oc}).

Table 2. Rate of thermal admittance into the internal wall surface in April 2019

Month	C.E.B. Configuration	Point	Mean Temp.	Std. Deviation	Overall Mean Temp.	SD
April	CEHHB	A	37.78	2.42	**35.75**	**2.147**
		B	38.26	2.63		
		C	38.47	2.64		
	CEVHB	A	38.33	2.75	37.92	2.59
		B	38.01	2.71		
		C	37.40	2.35		
	CECB	A	37.79	2.64	37.88	2.44
		B	37.73	2.67		
		C	38.10	2.72		
	CESB	A	38.13	2.73	37.68	2.58
		B	37.85	2.69		
		C	37.05	2.35		

However, the analysis of the three-month (March, April, and May 2019) internal wall surface temperature monitoring data of C.E.B. configurations (C.E.H.H.B., C.E.V.H.B., C.E.C.B., and C.E.S.B.) reveals month of April was having higher overall mean temperature as 35.75 ^{oc} as presented in table 2, the month of March 35.35^{oc} as shown in table 1 and then the month of May as indicated in table 3 having the least overall mean temperature 35.26 ^{oc}, respectively. Moreover, this is an affirmation that the month of April has a higher temperature.

Table 3. Rate of thermal admittance into the internal wall surface in May 2019

Month	C.E.B. Configuration	Point	Mean	Std. Deviation	Overall Mean	SD
May	**CEHHB**	A	35.53	2.97	**35.26**	**2.81**
		B	35.74	2.93		
		C	36.12	2.59		
	CEVHB	A	36.87	3.12	36.59	2.93
		B	36.58	3.04		
		C	36.34	2.65		
	CECB	A	36.66	2.92	37.10	2.15
		B	36.39	2.71		
		C	38.23	2.76		
	CESB	A	36.86	2.76	37.01	2.96
		B	37.04	3.03		
		C	37.15	3.10		

A further statistical test was conducted to examine whether there is a clear and statistical difference in the heat permeation/thermal admittance between the four different C.E.B. Configurations. The mean rate of the thermal admittance of the four C.E.B.s configuration was used to conduct a test of differences. The coefficient of the difference was determined using One-Way Analysis of Variance (ANOVA) at a 5% level of significance as presented in table 8.

Table 4. Rate of thermal admittance C.E.B configuration

Test Variables		Sum of Squares	df	Mean Square	F	Sig.
Thermal Admittance	Between Groups	20666.982	3	6888.99	799.72	.000
	Within Groups	922894.75	107136	8.61		
	Total	943561.73	107139			

The F statistics (107136) = 799.72 and Sig (P-value) = 0.000, = 0.05 for the Thermal Admittance are reported in Table 4 as the test result for differences using the One-Way ANOVA achieved. The analysis showed that the four C.E.B. configurations (C.E.H.H.B., C.E.V.H.B., C.E.C.B., and C.E.S.B.) have considerably varied mean thermal admittance values (because the p-values are greater than the alpha value of 0.05). As a result, for the duration of the experiment, the thermal admittance of the four different C.E.B. configurations is not the same.

Since this result demonstrates a statistically significant difference in Thermal Admittance between the four C.E.B. configurations (C.E.H.H.B., C.E.V.H.B., C.E.C.B., and C.E.S.B), it is unclear where the difference exists. Multiple comparisons (Turkey post-hoc-test) were performed to determine whether groups differed from one another. Table 5 shows the post-doctoral test.

Table 5. Thermal admittance (Tukey HSDa)

S/N	CEB Configuration	N	Subset for alpha = 0.05			
			1	2	3	4
1	CEHHB	26785	**35.7493**			
2	CESB	26785		36.6300		
3	CEVHB	26785			36.7660	
4	CECB	26785				36.8470
	Sig.		1.000	1.000	1.000	1.000

The means for groups in homogeneous subsets are indicated.

a. Harmonic Mean Sample Size = 26785.000 is used

A Tukey post hoc test result (mean) of the four groups reported in tables 4 and 5 revealed that C.E.H.H.B. has a stronger thermal resistance advantage, with the lowest heat permeability of 35.7, followed by C.E.S.B., which has a heat permeation of 36.6. The C.E.V.H.B. has a mean of 36.7 as well. Finally, C.E.C.B. has the highest mean value at 36.8. This stance is further illustrated in Figure 11 by a homogeneous mean plot.

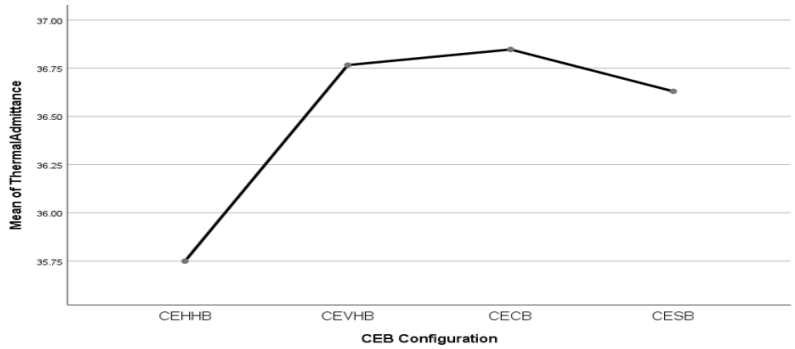

Figure 11. Thermal admittance by C.E.B

The data collected using Testo infrared thermometer was also analysed using spss statistical analysis software package to identify the (C.E.B) configurations; with lower rate of thermal admittance via external to internal C.E.B configurations experimental chambers, respectively.

Table 6. C.E.B wall surface temperature values in 10th April 2019

S/N	C.E.B Configuration	C.E.B Diagram	Internal wall surface Temperature
1	CEHHB		**36.0**
2	CEVHB		38.4
3	CECB		37.8
4	CESB		37.4

Inferring to obtained result from the testo infrared thermometer presented the table 6, table 7, and table 8. The result shows the (C.E.H.H.B.) has a lower rate of heat permeation values than C.E.B configurations; compressed earth horizontal hollow brick (C.E.H.H.B), compressed earth vertical hollow brick (C.E.V.H.B), compressed earth cellular brick (C.E.C.B), and compressed earth solid brick (C.E.S.B) respectively. However, the result shows C.E.H.H.B has a better thermal resistivity considering the values of the results obtained with the aids of using an infrared thermometer.

Table 7. C.E.B wall surface temperature values in 20th April 2019

S/N	C.E.B Configuration	C.E.B Diagram	Internal wall surface Temperature
1	CEHHB		**34.3**
2	CEVHB		36.2
3	CECB		35.8
4	CESB		35.5

Table 8. C.E.B wall surface temperature Values in 30th April 2019

S/N	C.E.B Configuration	C.E.B Diagram	Internal wall surface Temperature
1	CEHHB		**34.5**
2	CEVHB		35.6
3	CECB		36.8
4	CESB		38.5

The result in Table 6, Table 7, and table 8 reveal that compressed earth horizontal hollow brick (C.E.H.H.B.) has the least heat admittance through the west wall internal surface temperature (heat gain) of (36.0^{oc}), (34.3^{oc}), and (34.5^{oc}) between the other C.E.B configurations, and this has indicated that the C.E.H.H.B. has a better thermal resistance in comparison to another C.E.B configuration.

4.0 Result and Discussion

The outcome of the study analysis reveals that the C.E.H.H.B configuration has least rate of heat transfer via wall component of the building compared to its other C.E.B configurations. The comfortable building indoors environment depends on the lower rate of thermal admittance of the wall building material. The C.E.H.H.B is the prepared C.E.B configuration for constructing school buildings in hot and dry regions of northwestern Nigeria. Due to its numerous sustainable advantages for enhancing the students' healthy indoor living conditions and improving their learning activities and academic performance. C.E.H.H.B designed configuration is an appropriate wall construction material for a school building in hot and arid zone areas.

5.0 Conclusion:

The study indicated that embracing (C.E.H.H.B) as a sustainable wall material for constructing of school buildings in northwestern Nigeria has a manifold advantage apart from enhancing teaching and learning activities. It also boosts students' comprehension due to the conducive interior spaces that enable the building's indoor environment suitable for learning. Moreover, other building typologies in the study area could equally enjoy. Benefits from using (C.E.H.H.B) as a wall construction material in any other part of the world with a similar climatic condition as hot and arid zone could also benefit from the study findings and adopt (C.E.H.H.B) configuration as a sustainable wall material for the construction of buildings.

Acknowledgements

We would like to thank the management of The Waziri Umaru Federal Polytechnic for their assistance and enabling environment in carrying out this research, as well as TETFUND for giving the funding opportunity to carry out this research as part of the research project intervention.

Conflict of interest

The authors state that they have no conflicts of interest.

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