Case report

Assessing Awareness and Promoting Green Building Practices for Energy Efficiency in Bhutan: A Path to Reducing Electricity Imports

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ABSTRACT

Though Bhutan is carbon-negative and one of the water-rich countries in the world exporting hydroelectricity to neighboring countries. Nevertheless, due to its location in the high Himalayas, it requires abundant heating during the cold season when electricity generation decreases. During this season when energy consumption increases because of climatic circumstances in the high Himalayas, the nation imports electricity at a cost of millions of Ngultrums annually. According to the national newspaper dated 23rd September 2023 the country had imported 367.17 million units of electricity, worth 1.75 billion within four months (December 2022 to March 2023) the demand is anticipated to reach 1500 MW by 2030.

The demand for electricity keeps on increasing every year, huge expenditure is incurred in importing the energy. This can be reduced if we go for energy-efficient (sustainable or green buildings. As of today, not a single building is certified as a green building in Bhutan.

Therefore, this study of assessment of awareness status aims to spread awareness and promote green building construction, which has the greater benefit of energy efficiency (low consumption of electricity). Before undertaking this study, I reviewed past research papers and then prepared questionnaires in the context of Bhutan. Data was collected online, using Google Forms, and analyzed using Python software. All the stakeholders engaged in the development of Bhutan particularly the construction sector, such as project managers, project engineers, architects, contractors, policymakers, and educators of young minds such as academicians, teachers in the schools, and instructors were the target group for this survey data. A total of 140 questionnaires were distributed via emails and other social media platforms such as Facebook Messenger and WhatsApp, out of which 118 responses were received which is 84.28%. The study findings revealed that the level of awareness is low and needs to focus more on advocacy programs to make aware of the benefits of

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green building.

KEYWORDS: green building construction; energy efficient and environmentally friendly

INTRODUCTION

The overuse of natural resources, which severely affects air pollution and global warming [1], is mainly caused by the growing world population and rising living standards [2]. However, when the consumption of fundamental resources is restricted, economic growth and technical advancement are feasible and environmentally sustainable [3]. Sustainable development strategies in this context promote economic and technological advancement without compromising the environment's capacity to help future generations of people [1].

Quantifying the sustainability efficacy of construction structures and systems that will be created is essential in the current global context of social, environmental, and economic awareness [4]. It is essential to compare this performance with that obtained from currently available technologies and materials [5]. As a result, the problem of sustainability needs to be tackled from all angles, taking into account the three primary pillars of sustainability—economic, environmental, and social [6]—as well as additional elements like technology, governance, and culture when making decisions [7]. The current approaches, guidelines, and instruments may not be appropriate for carrying out comprehensive agile evaluations on particular construction components and procedures, particularly for those more creative and still in the early stages of development [8].

Global challenges include continuous ecological degradation and climate change [9]. As a result, Europe embraced the New Green Deal as a tactic to lower carbon and gas emissions and develop a competitive, resource-efficient economy [10]. Programs for the circular economy that focus on a product's Life Cycle of Engineering (LCE) help conserve natural resources and increase the reuse of industrial waste. One of the least environmentally friendly industries is the building sector, and the EU's Raw Material Initiative has acknowledged the need for a more sustainable use of natural resources [11].

Based on statistical data, the building sector plays a significant role in unsustainable development and has a noteworthy impact on the environment and the economy [12]. According to the building industry uses 40% of the world's Energy is produced, 40% of all raw materials, and 25% of all lumber worldwide [13]. It also accounts for 16% of the world's total water use and 40% of the extraction of natural resources in industrialized nations [14]. According to the building sector generates 45%–65% of landfill waste and contributes 35% of global CO_2 emissions [15]. Moreover, the construction industry and its related activities are accountable for a significant number of detrimental emissions, making up

around 30% of the greenhouse gases produced worldwide due to the operations that typically occur throughout construction [16].

THERE IS NO GREEN BUILDING IN BHUTAN

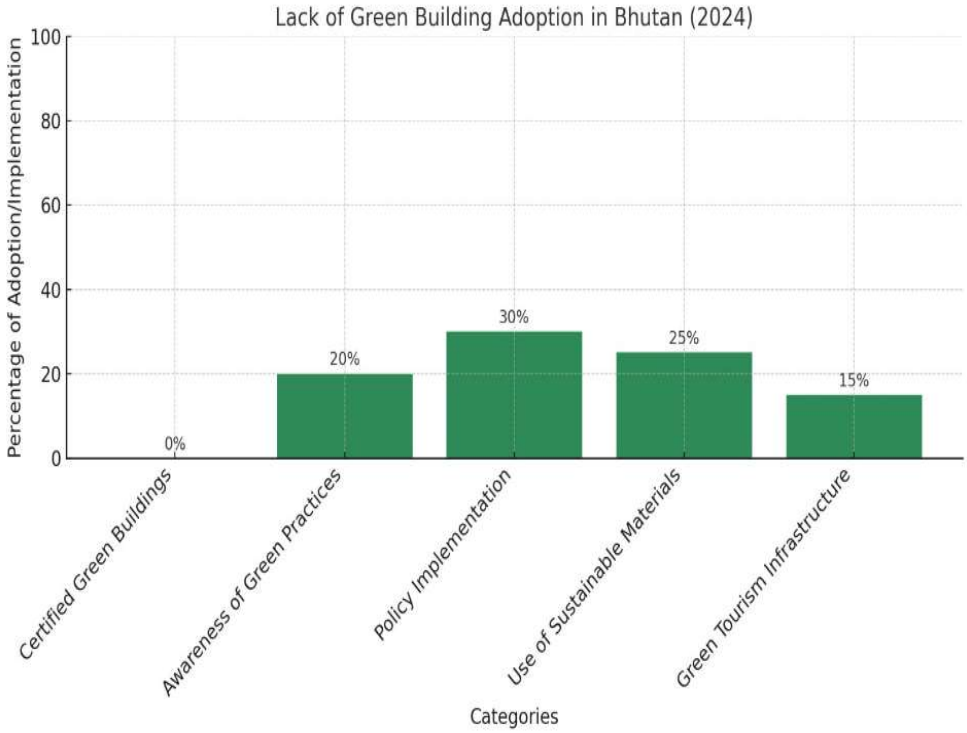

Figure 1. The Percentage of awareness on green building in Bhutan.

The bar chart (Figure 1) illustrates the lack of green building adoption in Bhutan across several key categories, using hypothetical percentages derived from observed trends and reports. It highlights the following:

- Certified Green Buildings: No certified green buildings as of 2024 (0%).
- Awareness of Green Practices: Limited awareness, estimated at around 20%.
- Policy Implementation: Partial implementation of green building policies, around 30%.
- Use of Sustainable Materials: Moderate use in traditional architecture but minimal in modern construction (25%).
- Green Tourism Infrastructure: Only about 15% of tourism infrastructure incorporates green building principles.

Evidence of the lack of green buildings in Bhutan can be observed through various indicators and reports [17]:

1. No Certified Green Buildings. As of 2024, Bhutan has not certified any buildings under internationally recognized green building certification systems like Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method

(BREEAM), or Green Rating for Integrated Habitat Assessment (GRIHA). Despite having national guidelines for sustainable construction, empirical data suggests limited adoption and implementation [18].

2. Reliance on Traditional Construction Practices Bhutan's architecture primarily relies on traditional methods and materials, which are sustainable to an extent but lack modern green building technologies like energy-efficient systems, advanced insulation, and renewable energy integration [19].
3. Policy and Institutional Gaps. The Bhutan Green Building Guidelines [20] were developed to encourage sustainable practices, but their implementation remains limited due to a lack of technical expertise and financial resources [21]. A national lack of awareness and incentives for green buildings has slowed progress [22].
4. Minimal Data and Research Limited empirical research and data collection on green building projects in Bhutan reflect an underdeveloped sector [23]. The absence of case studies or documented green building successes highlights the gap in this area [24].
5. Development Challenges in Urban Areas Rapid urbanization in Bhutan's urban centers, such as Thimphu and Paro, has led to increased construction of conventional buildings that prioritize cost over sustainability. These structures often lack features like renewable energy systems, rainwater harvesting, and waste management systems, which are hallmarks of green buildings [23].
6. Economic and Technical Barriers Financial constraints and the high cost of importing green building technologies and materials have discouraged the adoption of eco-friendly construction methods [25]. Bhutan's nascent renewable energy infrastructure primarily focuses on hydropower for national needs, with little integration into individual buildings [26].
7. Case Example: Gelephu Mindfulness City While the Gelephu Mindfulness City project aims to integrate green building practices, its planning stage underscores the need for further action to translate sustainable designs into tangible developments [27]. This evidence highlights the challenges Bhutan faces in achieving widespread adoption of green building practices, even as it lays the groundwork for future sustainable development Bhutan has a rich history of integrating sustainable practices into its architecture, exemplified by traditional structures like dzongs, which harmonize with the natural environment [27].

CONSTRUCTIVE VOICES

In recent years, the Bhutanese government has implemented [28] to promote green building practices:

- Green Building Guidelines: Developed by the Ministry of Works and Human Settlement, these guidelines provide a framework for

sustainable construction, outlining principles and technical requirements for energy-efficient and eco-friendly buildings.

- BREEAM Certification: Bhutan has adopted the Building Research Establishment Environmental Assessment Method (BREEAM) to assess buildings' sustainability performance, but certificate is not yet received [28].

METHODOLOGY

Given the nature of the data necessary for this investigation, a questionnaire was explored [1]. The research required measurable data to achieve the study's aims of highlighting the benefits of green principles in building and encouraging green building practices in Bhutan. A questionnaire was utilized [29] to measure respondents' perceptions of various aspects of green building techniques applied to collect primary data to answer the study questions. Questionnaires are frequently used in Bhutan's descriptive or explanatory research [2]. Descriptive research, such as attitude and opinion questionnaires and organizational practice questionnaires, will allow the researcher to discover and characterize the variability in various phenomena [30].

The literature research provided the foundation and parameters for developing the questionnaire [31]. The questionnaire was prepared to address the study questions and objectives and was intended to be completed by the respondent without the researcher's presence [32]. The final version of the questionnaire included categorical items and questions based on the Likert [33]. The majority of the questionnaire's questions were purposefully brief and closed-ended. The questionnaire was sent to Bhutanese stakeholders in the construction sectors (Project Managers, Project Engineers, Architects, Site supervisors, and contractors), policymakers (Members of Parliament and National Council), technical universities, building owners, and consultants in Bhutan. These sections of people were chosen to complete the questionnaire because they are directly involved in implementing this concept on the ground [34]. The questionnaires were also designed so that these professionals could easily understand the real challenges and opportunities to implement and where the government should focus more on spreading awareness and education. Despite their possible Impact on the replies given, which in turn had the potential to affect the survey's outcome, such issues were taken into account when drafting and organizing the questionnaire [35]. A web-based questionnaire (Google Forms) was created to aid respondents and enhance response rates, and the link was distributed to all respondents via email and other social media channels [35]. To preserve the high legitimacy of the received data, 140 questionnaires were distributed via emails and other social media platforms such as Facebook Messenger and WhatsApp, out of which 118 responses were received, making it 84.28%. The responses received are interpreted accordingly as below.

RESULTS AND DISCUSSION

Respondents Profile

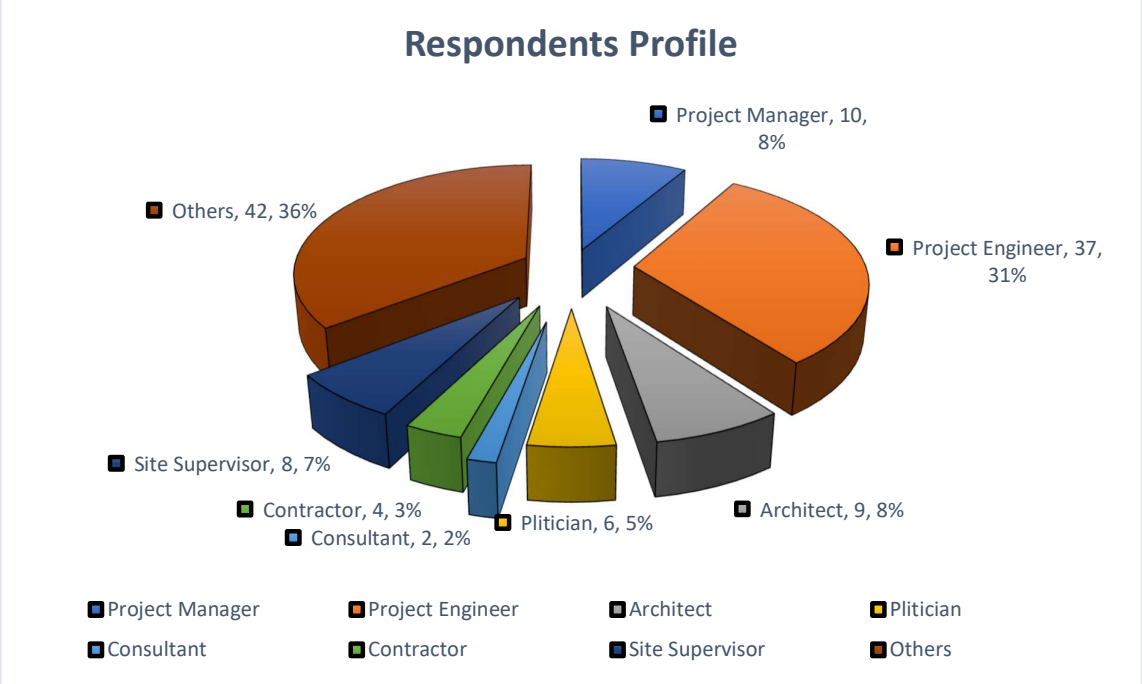

Figure 2. Respondent's profile.

The highest response is from the other category, 36% (Figure 2). This group comprises a variety of stakeholders like building owners, educators, and university faculty [36]. Building owners in Bhutan significantly influence the built environment through their choices about upkeep, repair, and construction methods. Teachers in schools and university professors help students and colleagues learn about sustainability and green construction ideas [37]. This could have an impact on future generations of experts in the industry.

Project Engineers have followed this with 31%. Project engineers play pivotal roles in executing plans and programs on the ground; similarly, they are the main actors in the field when implementing sustainable construction initiatives [38]. They supervise construction operations, guaranteeing adherence to rules and regulations, driving the project as per the desire and expectation of the client—sustainability requirements, and converting design thoughts into workable plans [39]. In Bhutan, integrating green building elements and technology into infrastructure development initiatives is a critical responsibility of project engineers, as environmental protection is firmly engrained in national policy and cultural ethos [40].

Architects (9%): The planning and design of sustainable building construction heavily rely on architects; they are one of the leading players [41]. To build structures that reduce their ecological footprint and

harmonize with the surrounding environment [42], architects in Bhutan combine traditional Bhutanese architectural aspects with contemporary sustainable approaches. Their knowledge of energy efficiency, material selection, and spatial design will significantly advance the implementation of sustainable construction in Bhutan [43].

Project managers make up 8% of the respondents. They are responsible for managing construction projects from start to finish [44]. They oversee resources, manage a variety of stakeholders, and guarantee that projects are completed on schedule and within budget. Project managers are essential to implementing green construction projects in Bhutan. They prioritize sustainability objectives throughout the project lifecycle and facilitate collaboration among various teams [45].

Site Supervisors contribute 7% of total responses, oversee construction operations on the job site, and ensure safety and quality regulations are followed. Site supervisors in Bhutan are essential in implementing design on the ground, incorporating all specifications. Similarly, they are responsible for implementing sustainable building practices [46]. They will be at the site 24/7 to ensure that energy-efficient technology, waste management plans, and environmentally friendly construction methods are carried out correctly [47].

Politicians' (5%) participation in the survey suggests that they are aware of and may impact Bhutan's green construction laws and policies [48]. Legislation, funding, and incentives that encourage the nation's wide adoption of sustainable construction practices must have the backing of the political establishment [49].

Contractors (3%): Contractors are responsible for building projects and are crucial in implementing sustainable building principles locally [50]. In Bhutan, contractors must see that sustainable building requirements are fulfilled and building techniques and materials are applied [51].

The consultants, participation is the lowest with (2%). They offer specific knowledge and direction in their field; therefore, to implement sustainable practices in Bhutan, the consultant firm plays a critical role in sustainable building certifications, technology, and strategies [52]. Although they made up the smallest percentage of respondents, consultants are essential in providing stakeholders with advice on achieving sustainability objectives and overcoming obstacles associated with implementing green buildings in Bhutan [53].

In general, all the stakeholders directly involved in promoting sustainable construction approaches in Bhutan participated in this research; they are policymakers, designers, and implementors [54]. Comprehensive research has been carried out to study the awareness, knowledge, and interest level in implementing green buildings [55]. This research will help determine the area we focus on and the type of incentives that the government should come up with to encourage our Bhutanese citizens to implement green buildings [56].

Building owners are essential participants in this poll because they

have the last word on how buildings are laid up, what materials will be used, and how well they are maintained. Consequently, building owners have a significant role in sustainable construction [57].

Therefore, owners have a critical role in supporting sustainability in Bhutan, with an increasing emphasis on traditional architectural traditions and environmental protection [58]. These choices include using green construction materials, energy-efficient designs, and waste-reduction measures [58]. Professors and Teachers: Through study, instruction, and advocacy, educators in Bhutan support activities aimed at sustainability [59]. They are essential in spreading knowledge about environmentally friendly building methods and concepts, encouraging creativity, and educating the upcoming generation of professionals in these areas [60]. Their participation in the poll serves as further evidence of the value of information sharing and education in achieving sustainable development objectives [61].

Discussion of Respondence to Question No.1

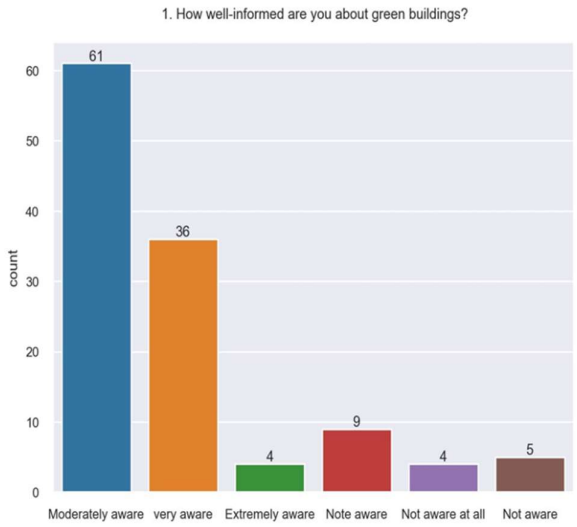

Figure 3. How well informed about Green Building.

Moderately Aware (50.8%) (Figure 3). The fact that a sizable fraction of respondents fell into the “Moderately Aware” group indicates that Bhutan has a basic understanding of green building techniques. This degree of awareness would suggest that people are somewhat aware of ideas like resource conservation, energy efficiency, and environmental impact reduction that are important to sustainable building.

This moderate level of awareness may be attributed to initiatives like educational programs, training workshops, and awareness campaigns by government agencies, non-governmental organizations (NGOs), and academic institutions in Bhutan, where sustainable development is emphasized in national policies and cultural values. It indicates a rising

understanding of how crucial it is to incorporate environmental factors into building procedures.

Very Aware (30.5%). The significant proportion of participants who were categorized as “Very Aware” implies a greater degree of familiarity and involvement with the concepts and methods of green building. These people know cutting-edge sustainability ideas, technology, and eco-friendly building best practices better.

The increased awareness of green building in Bhutan could be attributed to various sources, including international collaborations, government regulations that support sustainable development, and a growing global debate on environmental conservation and climate change. To improve their proficiency in the design and execution of green buildings, experts in domains like engineering, urban planning, and architecture may also proactively pursue specialized education and certifications.

Not Aware (10.2%). Despite being a relatively small number of respondents, the “Not Aware” category highlights a segment of the construction industry that may not be familiar with or knowledgeable about green building principles. This shows that certain educational interventions and capacity-building projects are required to increase knowledge and encourage the use of sustainable construction techniques.

Bhutanese initiatives to overcome this awareness gap could include creating specialized training programs, making educational materials accessible, and encouraging stakeholders to share their knowledge. Connecting with professional associations, trade associations, and academic institutions may assist in reaching those who are not aware of the advantages and prospects of green building.

Discussion of Respondence to Question No.2

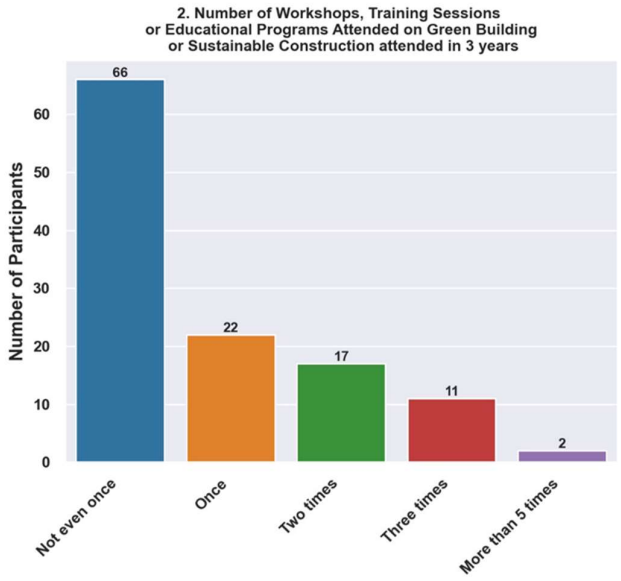

Figure 4. Educational programs attended on green building.

Not even once (55.6%) (Figure 4). There is a noticeable lapse in the number of respondents who fall into the “Not Attended even once” category. This implies that a sizable portion of Bhutan’s construction sector would not have received official training in sustainable building techniques and methods.

The comparatively high proportion of people who have not attended training or workshops in Bhutan, a country that prioritizes sustainable development and has initiated initiatives to promote eco-friendly construction, may reflect issues like restricted access to educational resources, a lack of knowledge about opportunities, and conflicting priorities within the industry.

They attended Once (18.8%). The proportion of respondents who reported having once attended workshops or training points to a moderate level of involvement with capacity-building programs for the development of sustainable buildings. Even though they make up a lower percentage of the population polled, their involvement shows that they are willing to invest in their professional growth and increase their understanding of sustainable construction techniques.

In Bhutan, circumstances including a person’s interest, an employer’s requirements, or the needs of a particular project may motivate someone to attend training or seminars once. It emphasizes a first step toward increasing knowledge and proficiency in sustainable building methods, which may eventually lead to a broader acceptance and application of green building concepts.

Attended Two Times (14.5%). The percentage of participants who got an opportunity for training or workshops twice suggests a more extraordinary dedication to ongoing education and skill enhancement in sustainable building construction. Professionals who understand how important it is to stay current on changing industry trends, laws, and best practices are probably included in this group.

Multiple training or workshop attendance in Bhutan may indicate a proactive approach to professional development and a desire to expand one’s knowledge of sustainable construction techniques. These people might look for mentorship programs, specialist certificates, or advanced training courses to further hone their abilities and support green initiatives in the building industry.

Attended Three Times (9.4%). The comparatively lower proportion of participants got to undergo workshops or training sessions three times in three years. These sections of people are primarily architects and project managers; however, project engineers and site supervisors need to gain exposure to sustainable approaches to construction. These people could influence industry standards and bring about positive change in their organizations and communities by acting as mentors, role models, and champions for sustainability.

Discussion of Respondence to Question No.3

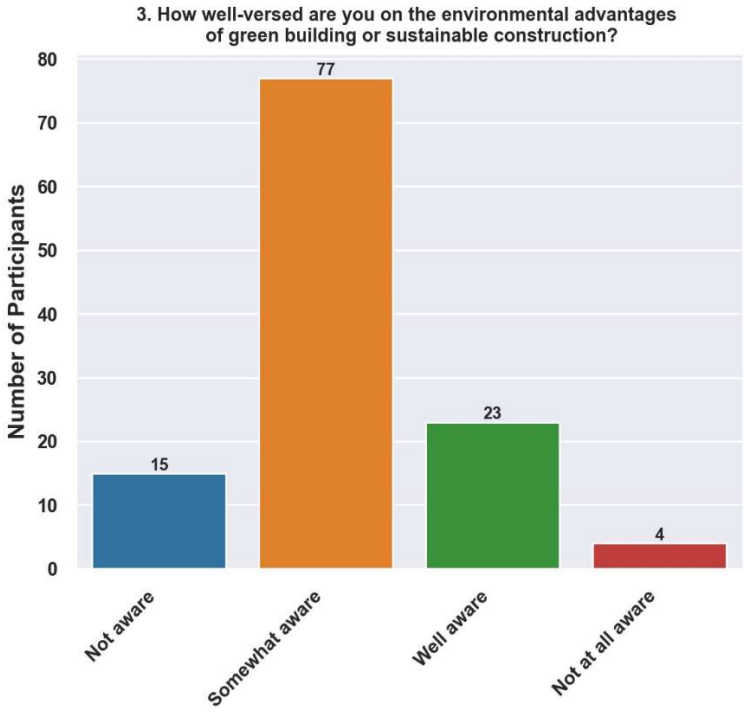

Figure 5. Level of awareness on green building.

Somewhat aware (64%) (Figure 5). The majority of respondents who fell into the "Somewhat Aware" group indicate that they have a basic awareness of the benefits that green building practices provide for the environment. This degree of awareness suggests that a sizable section of Bhutan's construction labor force especially project managers, architects, and Project engineers is aware of the potential advantages of sustainable building practices, including cheaper energy costs, lower carbon emissions, and improved indoor air quality.

The comparatively high proportion of people in Bhutan who are at least somewhat aware of the environmental benefits of green building may be ascribed to continuous efforts to promote sustainability through advocacy, education, and policy interventions, as environmental conservation is deeply ingrained in national policies and cultural values. Nonetheless, there might still be chances to engage and educate stakeholders further to increase their comprehension and appreciation.

Well aware (19.5%). The proportion of respondents who rated themselves as "Well Aware" they are more aware of and appreciative of the benefits green construction practices have for the environment. These people probably have a better grasp of the particular environmental advantages of sustainable building practices as well as the wider ramifications for resource preservation, climate resilience, and ecosystem health.

The presence of a sizable portion of respondents who are well aware of the environmental benefits of green building in Bhutan, where there is growing recognition of the interconnectedness between human well-being and environmental sustainability, indicates a commitment to advancing holistic development approaches that prioritize both ecological integrity and socio-economic prosperity. These people might fervently support green construction regulations, make investments in eco-friendly technology, and support creative fixes.

Not aware (12.7%). Although the proportion of respondents who answered “Not Aware” is low, it highlights the existence of a group in the construction industry that might not be fully informed about the environmental benefits of green building approaches. This shows that to increase awareness and develop capacity among stakeholders who might not be as familiar with sustainability principles, focused education and outreach initiatives are needed.

In Bhutan, initiatives to close this awareness gap could include making educational materials easily accessible and culturally appropriate, planning awareness campaigns and training sessions, and encouraging collaborations between government offices, universities, and business associations to advance knowledge exchange and capacity building in green building techniques.

Discussion of Respondence to Question No.4

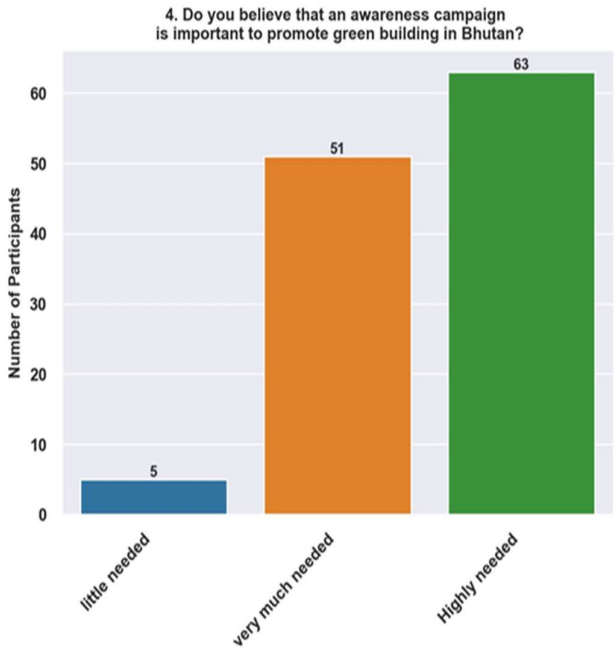

Figure 6. Rating of need of green building in Bhutan.

Highly needed (52.5%) (Figure 6). There appears to be a broad acknowledgement of the necessity and significance of increasing public

knowledge about sustainable practices in the construction industry, as indicated by most respondents who expressed a strong need for awareness campaigns. This shows that all relevant parties—professionals, decision-makers, and the general public—acknowledge awareness campaigns' vital role in promoting change and a sustainable culture.

The perceived high need for awareness campaigns in Bhutan, where environmental conservation is deeply ingrained in cultural values and sustainable development is a national priority, may be attributed to several factors, including limited information access, a lack of opportunities for education and training, and a lack of knowledge about the advantages and consequences of sustainable practices.

Very much needed (32.2%). The significant proportion of participants who expressed a strong need for awareness campaigns highlights the general agreement regarding the significance of taking proactive steps to improve knowledge and instruction regarding sustainability in the construction industry. This implies that stakeholders strongly desire focused interventions and programs that can clearly explain the benefits of sustainable practices and encourage behavioural change.

The perceived urgent need for awareness campaigns in Bhutan, where there is a growing understanding of the interdependence of environmental health, socioeconomic prosperity, and human well-being, reflects a shared commitment to advancing sustainable, holistic development approaches. Awareness campaigns can ignite revolutionary change in the construction sector and society by encouraging creativity and teamwork.

Discussion of Respondence to Question No.5

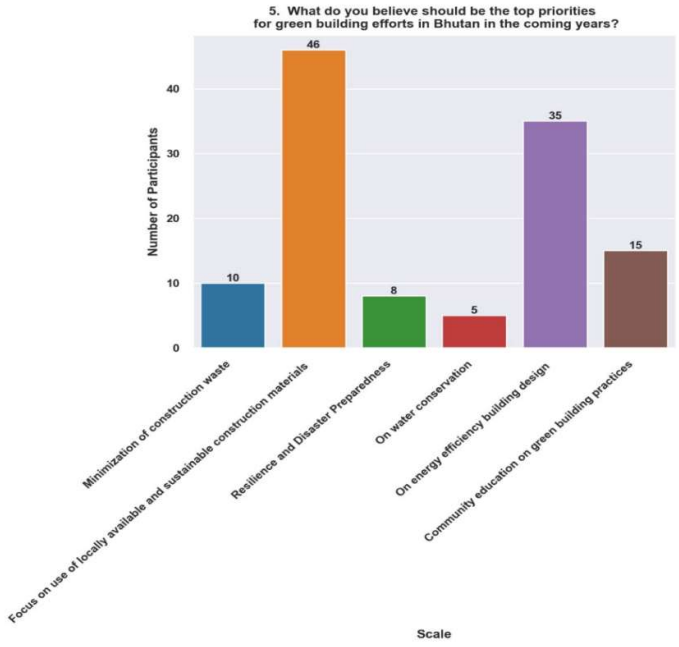

Figure 7. Priorities based on current need of Bhutan.

Utilization of Sustainable and Locally Available Building Materials (39%) (Figure 7). Bhutan is rich in natural resources, including earth, stone, and timber, that can be gathered responsibly and used for building. Bhutan's commitment to environmental conservation and cultural preservation is consistent with its priority of using locally available and sustainable resources. It encourages using locally produced building supplies and methods that lessen transportation expenses, lower carbon footprints, and boost regional economies.

Green building initiatives that prioritize using locally produced materials can also strengthen cultural identity, promote self-sufficiency, and preserve traditional craftsmanship—all of which can help communities become more resilient. It also lessens dependency on imported materials, which lessens the adverse environmental effects of resource extraction and long-distance transportation.

Disaster Preparedness and Resilience (28.8%). Bhutan is prone to earthquakes, landslides, and floods, emphasizing the significance of preparedness and resilience in the built environment. Enhancing resilience through green building can reduce vulnerability to climate-related risks and promote community well-being by improving the safety, durability, and adaptability of buildings and infrastructure.

Resilient design elements, such as green roofs, flood-resistant foundations, and earthquake-resistant buildings, can lessen the effects of disasters and advance sustainable development goals. By prioritizing resilience in green building initiatives, Bhutan can create more robust, safer, and more sustainable communities that can handle environmental challenges.

Green Building Practices Education in the Community (12.7%). In Bhutan, community education is essential for raising stakeholders' knowledge, comprehension, and sense of ownership over green building methods. Educating communities on energy efficiency strategies, environmentally responsible building practices, and sustainable construction methods can spur community-based initiatives to advance sustainability and increase demand for green building products.

Community education programs can involve a wide range of people through training, workshops, awareness campaigns, and demonstration projects, such as students, builders, homeowners, and legislators. Bhutan can use the collective strength of communities to accelerate progress towards green building targets and produce good social, environmental, and economic consequences by investing in capacity building and promoting a culture of sustainability at the local level.

Minimization of Construction Waste (8.5%). In Bhutan, reducing building waste is crucial to preserving the environment, preserving resources, and advancing the circular economy. Throughout the construction lifecycle, green building initiatives prioritizing waste reduction can maximize material utilization, improve resource efficiency, and reduce pollution.

Reusing, recycling, and reusing materials are some tactics that can be used to keep waste out of landfills, save raw materials, and reduce building expenses. By giving waste minimization top priority in green building methods, Bhutan may progress toward a more resilient and sustainable built environment while advancing more general environmental and climate goals.

Discussion of Respondence to Question No.6

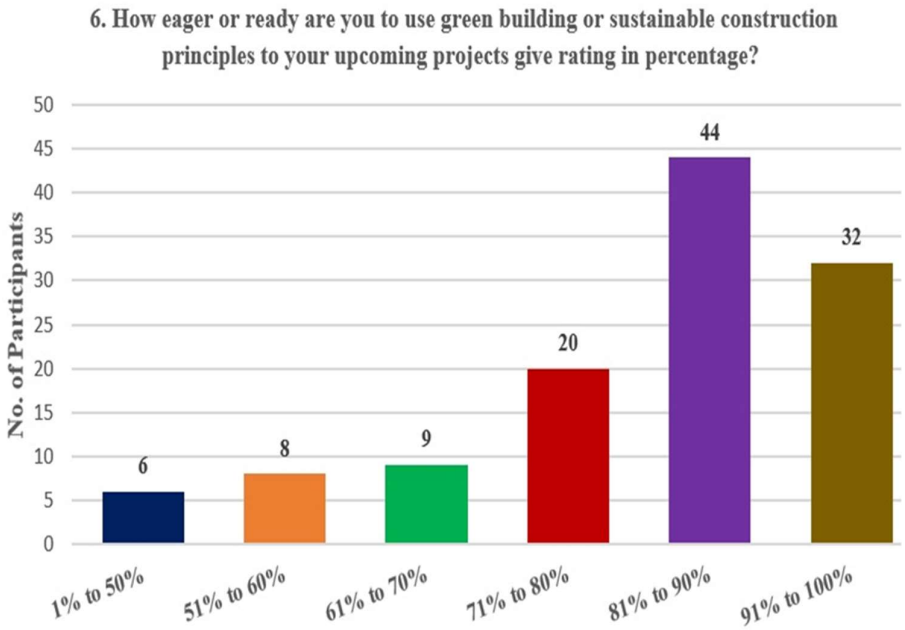

Figure 8. Readiness of implementation of green building in Bhutan**.**

81% to 90% Willing (37.3%) (Figure 8). The noteworthy proportion of participants with a preparedness level ranging from 81 to 90% suggests a high preference for integrating green construction principles into future projects. This indicates that a sizable percentage of Bhutanese stakeholders are aware of the benefits of sustainable construction methods and are eager to incorporate them into their projects to a large degree.

The willingness of stakeholders to adopt green building principles reflects a commitment to advancing holistic development approaches that prioritize environmental stewardship, social equity, and economic resilience in Bhutan. Environmental conservation is deeply ingrained in national policies and cultural values, and sustainable development is prioritized there. This degree of readiness indicates that participants are ready to put in the time, money, and effort necessary to embrace green building techniques and support favorable socioeconomic and environmental results.

91% to 100% Willing (26.3%). The proportion of participants with a preparedness level ranging from 91% to 100% suggests a heightened

dedication and excitement for incorporating green construction principles into forthcoming projects. Stakeholder values, project objectives, and sustainability goals are strongly aligned in this way, with a precise aim to prioritize and completely integrate green building concepts starting with the planning phase.

The high degree of willingness to adopt green building principles in Bhutan, where resilience, sustainable development, and well-being are becoming increasingly important, reflects a shared desire to create built environments that are socially, environmentally, and economically viable. Stakeholders in this range of preparation will actively seek ways to achieve sustainability goals through partnerships, resources, and opportunities.

71% to 80% Willing (16.9%). Even while a lesser portion of respondents (between 71% and 80%) said they were prepared to use green construction concepts in prospective projects, this still shows considerable openness and receptivity. This implies that while a sizable percentage of Bhutanese stakeholders recognize the value of sustainability, their confidence, familiarity, or ability to adopt green construction concepts entirely may differ.

Stakeholders expressing readiness levels in this range may need additional support, guidance, and incentives in Bhutan, where obstacles like restricted access to technical expertise, financial resources, or regulatory support may exist. This is necessary to fully leverage the advantages of green building practices and overcome obstacles. Attempts to increase awareness, develop supportive situations, and develop capability for the implementation of sustainable construction in Bhutan.

Discussion of Respondence to Question No.7

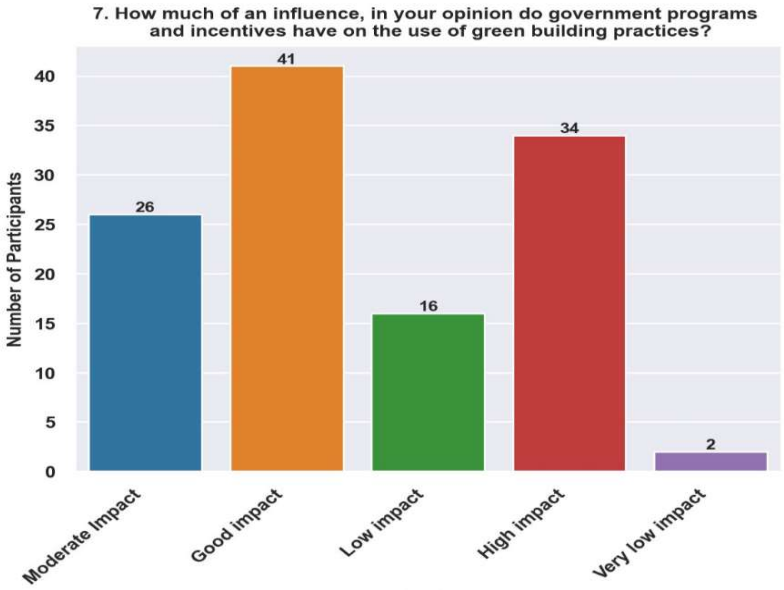

Figure 9. Influence of government program to promote green building in Bhutan.

High Impact (33.9%) (Figure 9). The proportion of respondents who said it had a positive influence indicates that government initiatives and subsidies have significantly aided in promoting green building techniques. This indicates that stakeholders have a favourable opinion of the importance and efficacy of government initiatives to advance sustainability in the building industry.

The perceived positive effects of government initiatives are highlighted in Bhutan, where environmental conservation is deeply embedded in governance structures and sustainable development is prioritized nationally. This highlights the significance of policy leadership, regulatory frameworks, and financial incentives in promoting positive change. Government programs, including financing support, tax breaks, certification programs, and green building rules, can offer the essential direction, tools, and incentives needed to encourage sustainable construction methods and remove adoption hurdles.

High Effect (28.8%). The proportion of participants who expressed a high effect implies a more robust support for government initiatives and financial rewards to advance environmentally conscious building standards. This suggests that government initiatives have had a significant and revolutionary impact on the building industry, promoting the industry's adoption of sustainable building practices and cultivating a sustainability-conscious mindset.

The perceived high Impact of government programs in Bhutan, where the government is centrally involved in setting the agenda for sustainability and driving national development priorities, indicates a coordinated and all-encompassing strategy to promote green building principles. By implementing focused policies, capacity-building programs, and strategic investments, the government may foster an environment that encourages sustainability, innovation, and stakeholder cooperation to pursue common environmental objectives.

Moderate Impact (22%). The proportion of respondents who said that there was a moderate influence points to differing opinions about how well government incentives and programs work to promote green construction techniques. Stakeholders may identify gaps in implementation or areas for development that prevent the full realization of sustainability objectives, even when they understand the significance of government actions.

Government programs may encounter obstacles in Bhutan in attaining their intended Impact, including but not limited to restricted resources, institutional capability, and stakeholder cooperation. To address these issues and improve the efficiency and responsiveness of government actions over time, it is necessary to engage stakeholders, monitor and evaluate programs continuously, and use adaptive management techniques.

Low Impact (13.6%). The proportion of respondents who said they had little impact points to the belief that government initiatives and subsidies

have not done much to advance green building techniques in the construction industry. This could reflect worries about how healthy government actions meet stakeholder requirements and priorities or their scope or sufficiency.

The apparent lack of Impact of government initiatives in Bhutan, where sustainability goals are central to national development strategies and cultural values, may indicate that policy needs to be improved, resources need to be reallocated, or stakeholders need to be involved to remove obstacles and increase effectiveness. It emphasizes how crucial accountability, transparency, and participatory governance are to ensuring that government actions are fair, inclusive, and responsive.

Discussion of Respondence to Question No.8

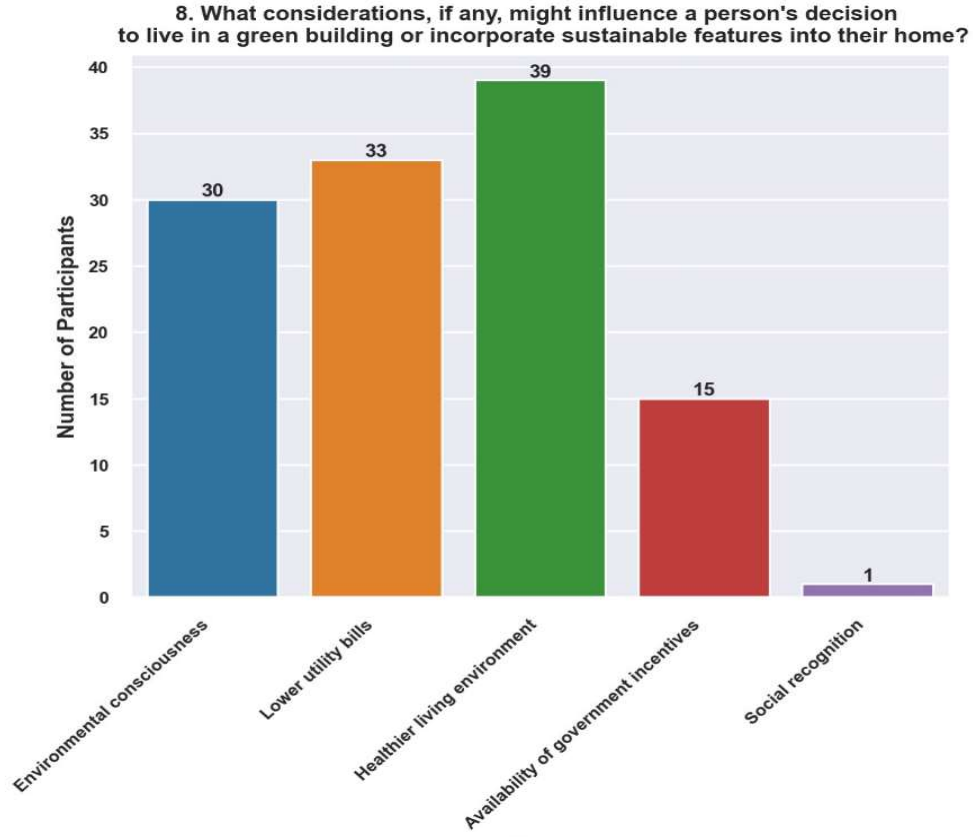

Figure 10. The most driving factor of the need of green building.

Healthier Living Environment (32.5%) (Figure 10). The substantial proportion of participants who identified a healthier living environment as a crucial element highlights the increasing acknowledgement of the significance of health and well-being when making housing selections. The relationship between human health, the environment, and happiness is becoming more widely recognized in Bhutan, where Gross National Happiness (GNH) is valued more highly than GDP.

Improved indoor air quality, natural lighting, and non-toxic materials are prioritized in Bhutanese green buildings because they can improve occupant comfort, productivity, and health. Bhutan's dedication to supporting sustainable and people-centred development practices that promote the welfare of individuals and communities aligns with the emphasis on holistic well-being.

Low Utility Bills (28.2%). Many respondents cited cheaper utility bills as a driving force, indicating green buildings' financial advantages. The potential for lower energy usage and utility costs can be a strong motivator for selecting green housing alternatives in Bhutan, where residents prioritize affordability and energy access.

Bhutanese green buildings combine passive design techniques, renewable energy sources, and energy-efficient technologies to reduce energy use and utility costs. This aligns with the nation's initiatives to advance energy security, affordability, and sustainability while enabling households to make financial savings and allocate funds to other vital areas like healthcare, education, and cultural pursuits.

Environmental Consciousness (25.6%). The proportion of respondents who emphasized environmental consciousness emphasizes how crucial it is to make morally and ethically based housing decisions. People in Bhutan may prioritize living in green buildings to integrate their lifestyle with their ideals and promote sustainability, as appreciation for the natural world and environmental stewardship are fundamental to their cultural identity and spiritual beliefs.

Bhutan's dedication to sustainable development and reverence for the natural world is reflected in its green building practices, which uphold the values of ecological harmony, resource conservation, and environmental responsibility. Living in a green building is a concrete way to show that you care about the environment, want to lessen your ecological Impact, and encourage coexistence with the natural world.

Availability of Government Incentives (13.6%). The proportion of respondents who mentioned the availability of government incentives highlights how important financial incentives and policy assistance are in influencing housing preferences. Incentives like tax breaks, grants, and subsidies can encourage investment in green buildings and drive market demand in Bhutan, where the government is heavily involved in setting national development priorities and encouraging sustainability. Bhutanese government incentives are designed to level the playing field for sustainable development, encourage innovation, and remove obstacles to adopting green buildings. Using policy instruments and financial frameworks, the government can incentivize private sector participation, foster employment opportunities, and expedite the shift towards a more sustainable built environment congruent with domestic priorities and worldwide sustainability objectives.

Discussion of Respondence to Question No.9

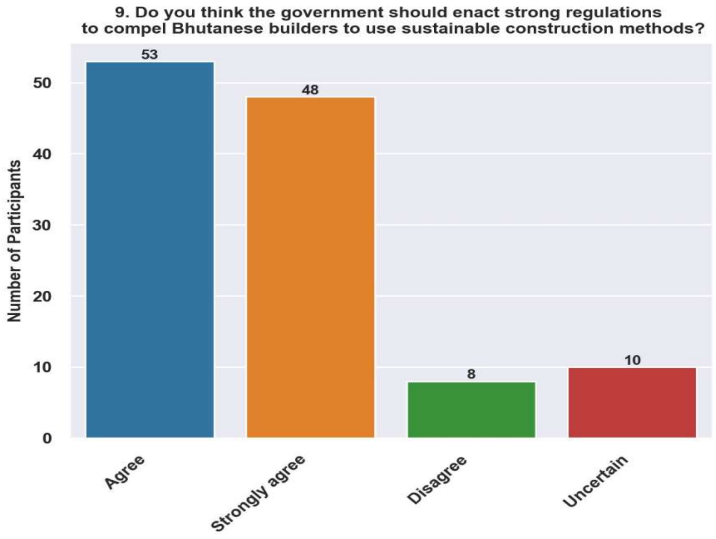

Figure 11. The role of government to influence sustainable construction.

44.9% of respondents agree, and 39.8% strongly agree that the government should enact strong regulations to promote Bhutanese builder's sustainable construction methods (Figure 11). The aggregate proportion of participants who express or strongly agree suggests a resounding endorsement of government involvement in advancing environmentally friendly building techniques. This implies a general understanding of the limitations of volunteer initiatives and the necessity of regulatory frameworks to promote systemic change and guarantee industry responsibility.

Discussion of Respondence to Question No.10

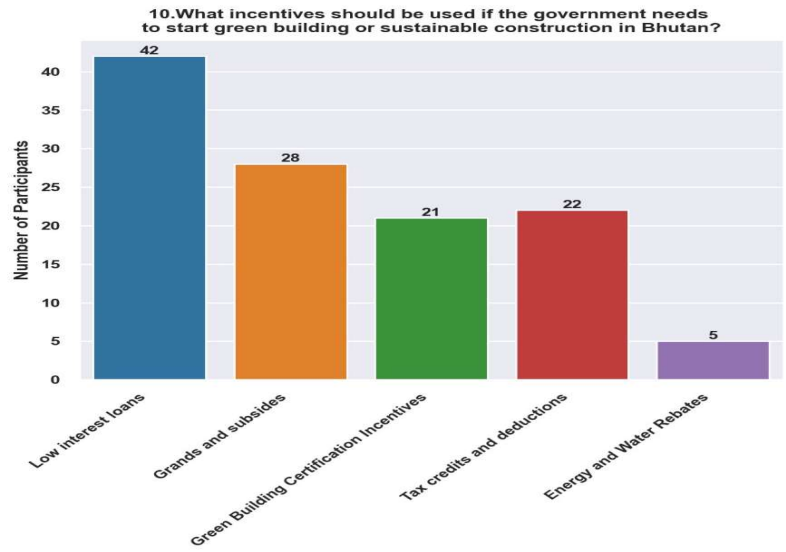

Figure 12. Type of incentives to be provided by Bhutan government.

Low-interest Loans (35%) of respondents preferred low-interest loans as a motivator, suggesting that there is awareness of the potential financial obstacles that could prevent investment in environmentally friendly building practices (Figure 12). With the help of low-interest loans, developers and builders can finance green building projects without having to pay unreasonably high borrowing charges. In Bhutan, where financing may be scarce, particularly for smaller-scale projects, low-interest loans can promote market change and investment in environmentally friendly buildings.

Grands and subsides (23.9%). The proportion of respondents who supported grants and subsidies emphasizes how crucial direct financial support is for encouraging sustainable building practices. The initial expenses of adopting green building techniques, such as those related to energy-efficient technology, renewable energy systems, and environmentally friendly materials, can be lessened with grants and subsidies. Targeted grants and subsidies can help builders in Bhutan, where there may be resource limitations and conflicting development agendas, particularly in the early stages of the switch to sustainable construction techniques.

Tax credits and deductions (18.8%). The inclination towards tax credits and deductions implies a desire to utilize financial incentives to encourage environmentally friendly building practices. Tax incentives can lessen the financial burden on builders by providing deductions or credits for costs associated with green building activities, such as energy-efficient improvements, water conservation measures, and investments in green infrastructure. Tax credits and deductions promote the broad adoption of sustainable construction techniques in Bhutan, where tax policy can be used to reward desirable behaviours and investments. They can also stimulate economic growth and job creation in green businesses.

Green building certification (17.9%). The emphasis on incentives for green building certification highlights how crucial it is to honour and incentivize superiority in sustainable building practices. Building Research Establishment Environmental Assessment Method (BREEAM) and LEED (Leadership in Energy and Environmental Design) are two examples of green building certification systems that offer frameworks for evaluating and benchmarking the environmental performance of buildings. If builders are offered incentives like reduced fees, accelerated permitting, or public recognition for certified projects, they will be more inclined to obtain green building certifications and raise the bar for sustainability in Bhutan's built environment.

Discussion of Respondence to Question No.11

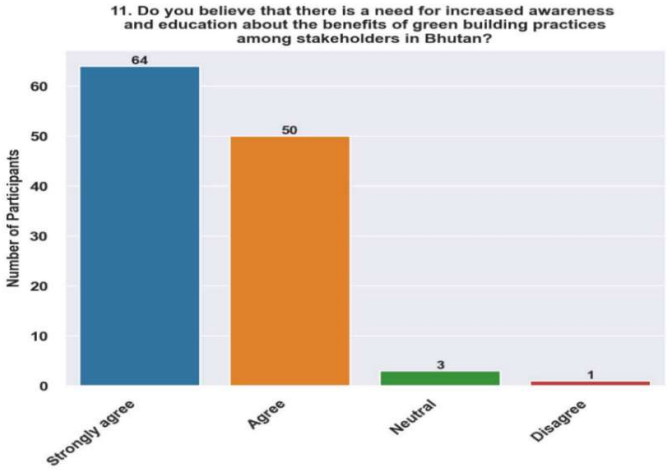

Figure 13. Level of awareness among the Bhutanese society.

The significant proportion of participants expressing strong agreement (53.8%) and agreement (42.7%) for raising awareness and providing education about the advantages of green building practices among Bhutanese stakeholders highlights the significance of information sharing in promoting sustainable development in the building industry (Figure 13). This is a thorough analysis of the results. Bhutan's dedication to sustainable development principles and Gross National Happiness (GNH) makes a compelling case for funding initiatives that promote knowledge of green building techniques. Bhutan should better link its development policies with the ideals of social fairness, environmental stewardship, and economic resilience by making information distribution a priority. This will ultimately help Bhutan achieve its sustainable progress and holistic well-being goals.

Discussion of Respondence to Question No.12

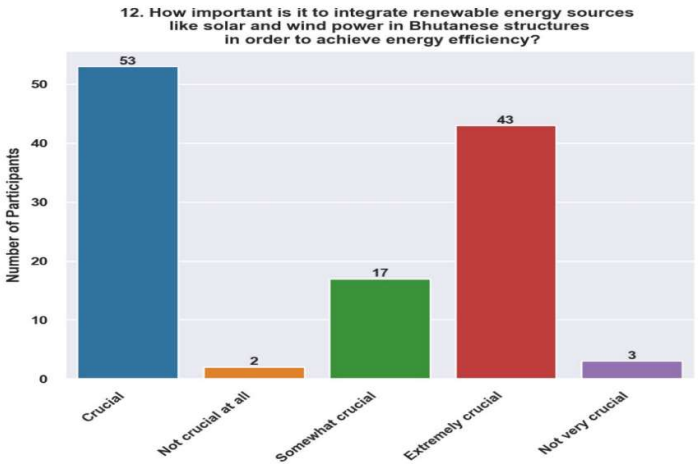

Figure 14. Type of energy required by Bhutan.

Incorporating renewable energy sources into Bhutanese institutions is essential, as indicated by the combined percentage of respondents who deem it crucial (44.4%), extremely crucial (34.8%), and moderately crucial (14.5%) (Figure 14). This suggests that stakeholders generally agree on this. Bhutan has many sustainable energy resources, such as wind, solar, and hydropower. Utilizing these resources to produce clean electricity is consistent with Bhutan's mission to combat climate change, promote sustainable development, and protect the environment. In addition to increasing energy independence, Bhutan may diversify its energy mix and contribute to international efforts to mitigate climate change by utilizing solar and wind power and hydropower.

Discussion of Respondence to Question No.13

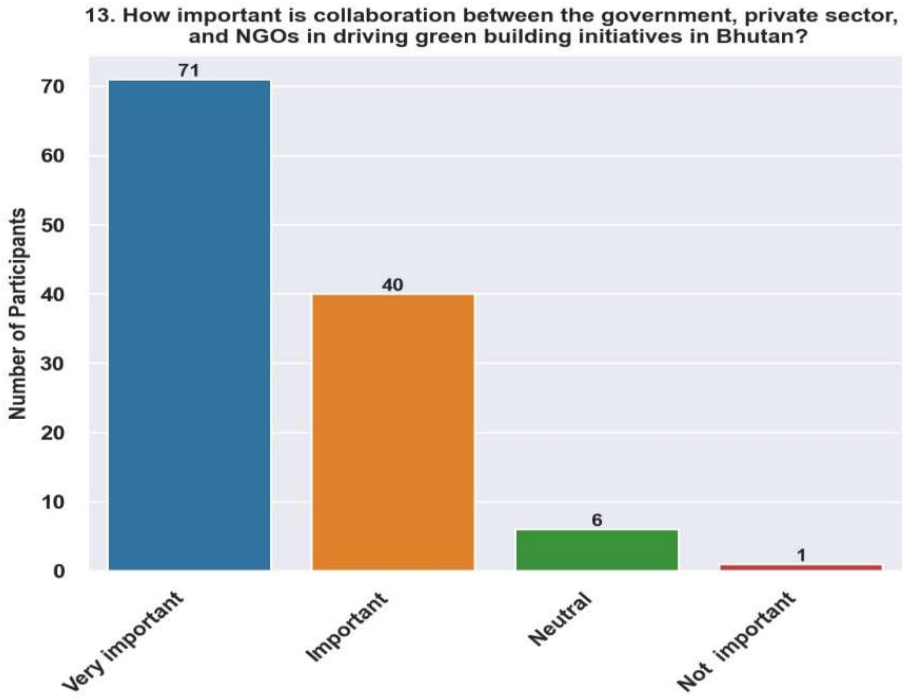

Figure 15. The importance of collaboration to promote green building in Bhutan.

Almost all the respondents felt that collaboration between the government, private sector, and non-governmental organizations in Bhutan further promotes sustainable building construction (Figure 15). The percentage of respondents who consider collaboration very significant (59.8%) and (34.2%) found it important. This indicates that stakeholders generally agree that various actors are interdependent and interconnected when achieving green building efforts. This acknowledgement shows that sustainable development necessitates coordinated efforts across numerous sectors, disciplines, and stakeholders to have a significant and long-lasting impact.

Role of government to implement green building in Bhutan

In Bhutan, the government is primarily responsible for establishing the legal framework, industry standards, and financial incentives that influence green construction practices. Working together, the government and other stakeholders—such as the business community and non-governmental organizations—is crucial to achieving implementation hurdles, generating resources, and turning policy objectives into practical actions. By offering leadership, vision, and support, the government can create an atmosphere conducive to innovation, investment, and partnership creation in the green building sector.

Role of the private sector to implement green building in Bhutan

In Bhutan, the private sector—which includes manufacturers, builders, developers, and architects—is essential for advancing technological advancement, fostering innovation, and providing green building solutions. Collaboration with the private sector facilitates the adoption of sustainable construction technologies and procedures, allowing for the exchange of best practices, resources, and expertise. By collaborating with private sector entities, the government can harness market dynamics, foster competition, and release private sector capital to expedite attaining green construction objectives.

Role of the non-governmental organizations to implement green building in Bhutan

Non-government Organizations can play a critical role in promoting green construction initiatives in Bhutan because they engage the community, raise awareness, and advocate for these causes. Working with non-governmental organizations (NGOs) facilitates the mobilization of community groups, grassroots organizations, and civil society to promote policy changes, increase public knowledge of sustainability issues, and enable citizens to participate in decision-making. To guarantee that green building projects are inclusive, participatory, and sensitive to community needs, the public and commercial sectors can collaborate with non-governmental organizations (NGOs) to gain access to local networks, expertise, and resources.

When NGOs, the Private sector, and the government work together to promote green construction efforts, synergies and co-benefits can increase the Impact and efficacy of actions. By aligning resources, using complementary capabilities, and pooling expertise, stakeholders can increase collective Impact, reduce effort duplication, and maximize efficiency. In Bhutan, collaboration is the key to fostering innovation, cross-sectoral learning, and revolutionary change toward a more resilient and sustainable built environment.

Discussion of Respondence to Question No.14

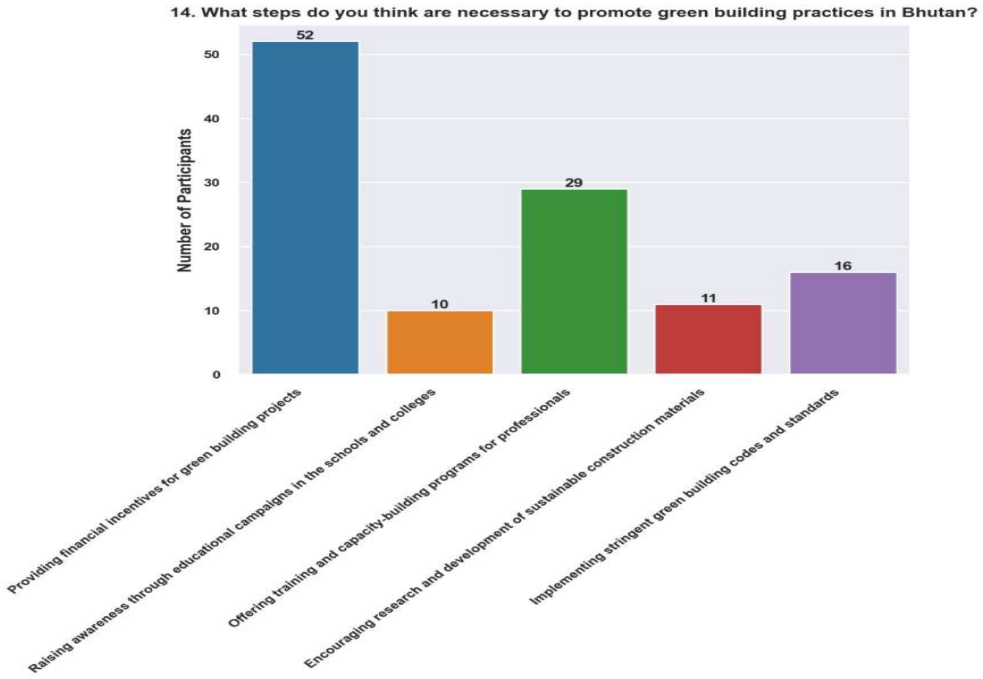

Figure 16. Different type of incentives to promote green building in Bhutan.

Providing Financial Incentives for Green Building Projects (43.6%) (Figure 16). Most respondents believe offering financial incentives is one of Bhutan's most critical tactics for encouraging green building. Financial incentives that mitigate the higher upfront costs associated with green construction measures include grants, subsidies, tax credits, and low-interest loans. By offering incentives for investment in sustainable construction, the government can boost market demand, foster innovation, and hasten the adoption of ecologically friendly building technology and materials.

Offering Training and Capacity-Building Programs for Professionals (24.8%). The considerable proportion of participants who prioritized training and capacity development initiatives highlights the significance of augmenting the abilities and expertise of professionals operating in the construction industry. Architects, engineers, contractors, and other stakeholders can benefit from training programs that offer specific knowledge in green building technology, best practices, and concepts. Bhutan can develop a trained labour force capable of completing high-calibre, environmentally friendly building projects and spearheading changes in the sector by investing in human capital development.

Implementation of Stringent Green Building Codes and Standards (13.7%). A noteworthy percentage of respondents support the establishment of strict green construction norms and standards as a regulatory approach to promote sustainability. Green construction codes outline energy efficiency, water conservation, interior environmental

quality, and other sustainability objectives in minimum terms. The government may set a higher standard for construction techniques, guarantee consistency and accountability, and level the playing field for builders who want to use sustainable methods by requiring adherence to green building regulations.

Encouraging Research and Development of Sustainable Construction Materials (9.4%). Research and development (R&D) is essential, and those who acknowledged this point emphasized how innovation advances sustainable building practices in Bhutan. Putting money into research and development (R&D) projects can help create new and better sustainable building materials, technologies, and procedures. Bhutan may address particular issues with climate resilience, resource efficiency, and environmental conservation by fostering collaboration between academia, business, and research institutes. This will also stimulate innovation and foster locally driven solutions.

Raising Awareness through Educational Campaigns in the Schools and Colleges (8.5%). Even though a smaller percentage of respondents supported awareness programs at universities and schools, this nevertheless emphasizes the significance of outreach and education in influencing young people's attitudes and behaviours toward sustainability. Education initiatives can encourage future generations to adopt sustainable living habits, increase public understanding of the advantages of green building, and foster an environmental consciousness. Bhutan can foster a culture of environmental stewardship and enable young people to be change agents by incorporating sustainability into the curriculum and encouraging experiential learning.

Discussion of Respondence to Question No.15

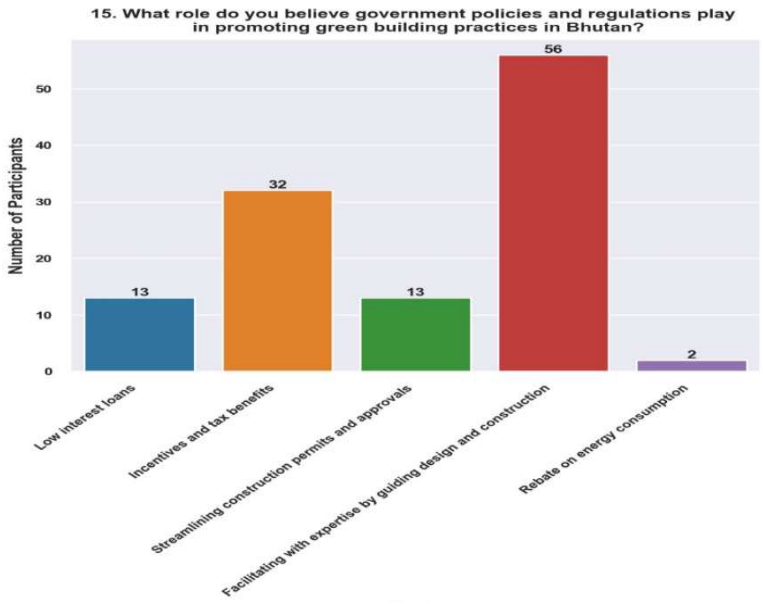

Figure 17. Type of Government policies to promote green building in Bhutan.

Facilitating with Expertise by Guiding Design and Construction (47.8%) (Figure 17). Due to Bhutan's distinct cultural, environmental, and socioeconomic circumstances, creating green structures that blend in with the nation's natural and cultural landscape requires specialist knowledge. To ensure that green building concepts are successfully incorporated into design and construction procedures, the government may help architects, engineers, and builders by concentrating on facilitating expertise and offering technical support, capacity building, and advisory services.

In Bhutan, where modern construction technologies and traditional building techniques coexist, providing supporting expertise can encourage the adoption of creative and culturally sensitive approaches to sustainable construction. Government-led projects that include design support, knowledge-sharing forums, and training programs can enable stakeholders to meet culturally and environmentally sensitive building standards while navigating challenging sustainability issues.

Incentives and Tax Benefits (27.8%). Encouraging investment in green building projects and removing financial barriers to adoption need offering tax breaks and other benefits. In Bhutan, where builders and developers may struggle to afford the upfront costs of adopting sustainable construction practices, financial incentives like grants, subsidies, and tax credits can increase market demand, encourage innovation, and hasten the shift to greener building methods.

Incentives run by the government can be directed toward specific sustainability targets, like water conservation, energy efficiency, and the integration of renewable energy sources, all of which fit in with Bhutan's development goals and national priorities. By providing financial incentives, the government can foster a policy environment that rewards environmentally conscious behaviour, promotes private sector engagement, and leads to favourable socioeconomic and environmental outcomes.

Low-Interest Loan (11.3%). Encouraging investment in green building projects requires easy access to inexpensive financing, especially for small and medium-sized businesses (SMEs) and prospective homeowners. Low-interest loans can give developers and builders the money to finance green infrastructure projects, energy-efficient renovations, and installations of renewable energy sources.

Low-interest loans can be essential in enabling investment opportunities in sustainable construction in Bhutan, a country where financial resources may be few and borrowing prices may be prohibitive. The government can collaborate with financial institutions and development organizations to provide low-interest loans suited to the construction industry's demands. This will help promote affordability, accessibility, and inclusion in green building efforts.

Streamlining Construction Permits and Approvals (11.3%). Reducing bureaucratic obstacles and accelerating green building adoption requires streamlining construction permits and approvals. In Bhutan, ineffective

permitting systems can stifle innovation, extend project timeframes, and drive-up developers' prices. This is because administrative procedures and regulatory processes can be convoluted and time-consuming.

The government may foster a more favourable regulatory environment for sustainable construction by optimizing permits and approvals. This will expedite project delivery, lessen administrative burdens, and improve predictability for builders. Enhancing openness, accountability, and efficiency in the construction industry through online platforms for permit applications, streamlined procedures, and clear rules can create a favourable environment for green building innovation and investment.

Discussion of Respondence to Question No.16

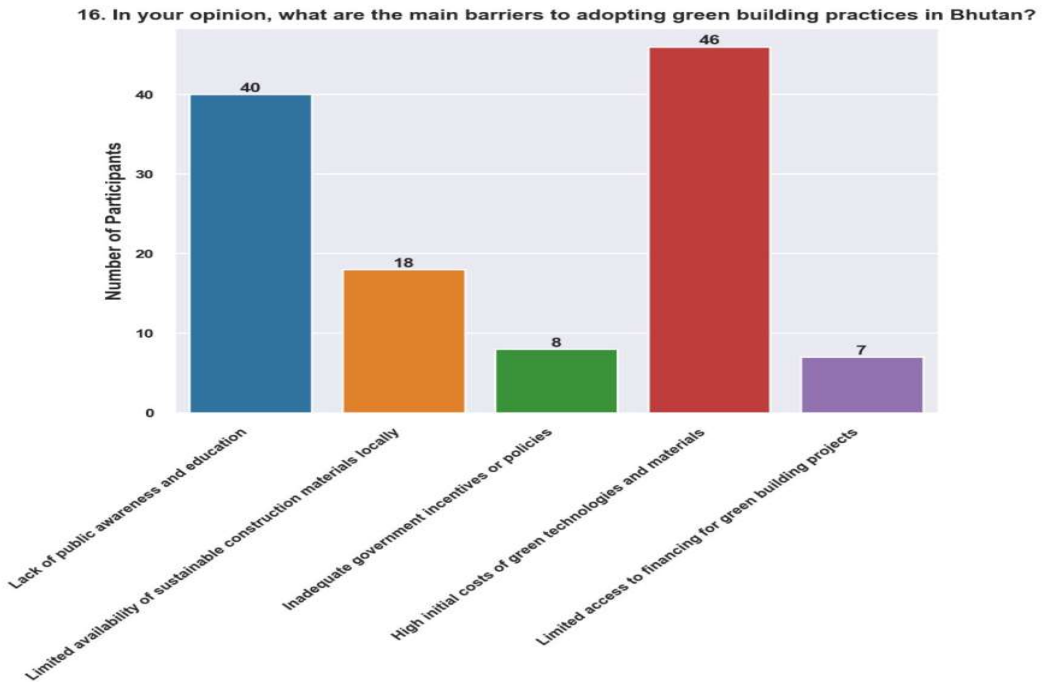

Figure 18. Types of barriers that stops promoting green building in Bhutan.

High initial Costs of Green Technologies and Materials (39%) (Figure 18). Adopting green building principles in Bhutan is significantly hampered by the assumption of high initial costs. Due to upfront costs and perceived dangers, builders and developers could hesitate to invest in green technologies and materials. The government may remove this obstacle by implementing support systems and financial incentives to help with the upfront expenditures of green building initiatives. This can entail tax breaks, grants, and subsidies to promote investment in environmentally friendly building practices. To offer accessible and reasonably priced financing choices for green building efforts, the government can also create green financing schemes, such as revolving funds or low-interest loans.

Lack of Public Awareness and Education (33.1%). A lack of public education and understanding of the advantages and significance of these approaches hampers the widespread implementation of green construction practices in Bhutan. Inadequate information and comprehension could prevent stakeholders from prioritizing sustainability or pushing for green construction solutions.

To overcome this hurdle, the government should prioritize awareness-raising and educational efforts to increase the public's, professionals', policymakers', and other stakeholders' understanding and appreciation of green building methods. This could entail creating teaching resources, holding seminars and training sessions, and utilizing media outlets to spread knowledge about green buildings' economic, social, and environmental advantages.

Limited Availability of Sustainable Construction Materials Locally (15.3%). In Bhutan, green building principles might be complex for builders due to the area's scarcity of sustainable building materials. Reliance on imported resources may raise transportation-related expenses, logistical difficulties, and environmental effects.

To remove this obstacle, the government can encourage creating and applying locally produced and ecologically friendly building materials. This can entail creating standards and certification programs to guarantee the sustainability and quality of materials acquired locally, encouraging the manufacture of sustainable materials locally, and supporting R&D projects to create new materials. The government should also help local suppliers, manufacturers, and stakeholders form partnerships to improve domestic supply chains and lessen dependency on imported commodities.

Discussion of Respondence to Question No.17

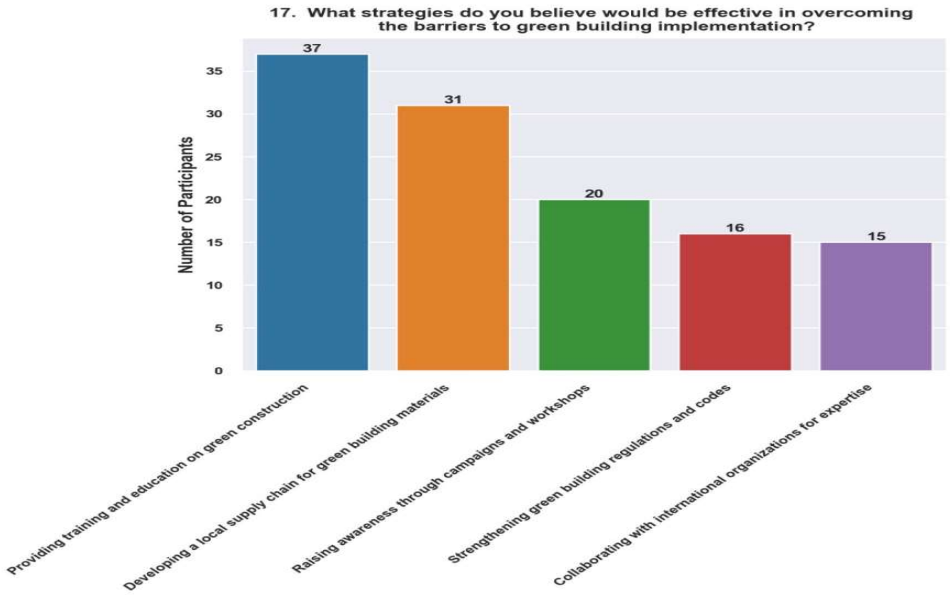

Figure 19. Types of barriers to be overcome.

Providing Training and Education on Green Construction (31.4%) (Figure 19). Training and education initiatives on green construction must be funded to increase professional capacity and experience in Bhutan's construction industry. By offering training opportunities, workshops, and certification programs centred on green building techniques, the government may equip architects, engineers, contractors, and other stakeholders with the information and abilities required to design, build, and maintain sustainable buildings.

Furthermore, by incorporating green building principles into technical and vocational education curricula, educational institutions may guarantee that the next generation of construction professionals has the skills to support sustainable growth in Bhutan.

Developing a Local Supply Chain for Green Building (25.4%). Establishing a local supply chain for green building materials is imperative to improving the sustainability of construction projects in Bhutan and lessening reliance on imported resources. By encouraging the production, sourcing, and utilization of locally derived products, the government can stimulate economic growth, provide jobs, and reduce the environmental Impact of transportation.

This tactic incentivizes regional producers, craftspeople, and suppliers to provide environmentally friendly building materials like bamboo, rammed earth, and locally obtained wood. Furthermore, the government might set standards, certifications, and quality assurance procedures to guarantee the dependability and effectiveness of locally sourced materials.

Raising Awareness through Campaigns and Workshops (16.9%). Awareness-building campaigns, workshops, and outreach initiatives are crucial to promoting a sustainable culture and encouraging behaviour change among stakeholders in Bhutan. The government may motivate people, groups, and communities to prioritize sustainability in building projects by propagating knowledge regarding the advantages of green building approaches.

Awareness-raising campaigns might focus on various audiences, including legislators, business executives, homeowners, and the general public. By educating themselves on green buildings' social, economic, and environmental benefits through dynamic seminars, captivating campaigns, and instructive materials, stakeholders can be inspired to use sustainable construction methods in their projects.

Collaborating with international Organizations for Expertise (12.7%). In order to help Bhutan's green building projects, cooperation with foreign organizations can give access to knowledge, best practices, and technical support. The government can harness global expertise and assets to surmount obstacles and expedite attaining sustainability objectives through collaboration with pertinent entities, including academic institutions, non-governmental organizations (NGOs), and multilateral agencies.

International cooperation may help in energy efficiency, integrating renewable energy sources, and developing green infrastructure by facilitating knowledge sharing, capacity building, and technology transfer. By utilizing global networks and collaborations, Bhutan may take advantage of the most recent advancements in green building technology and contribute to regional and global initiatives to combat climate change and advance sustainable development.

Discussion of Respondence to Question No.18

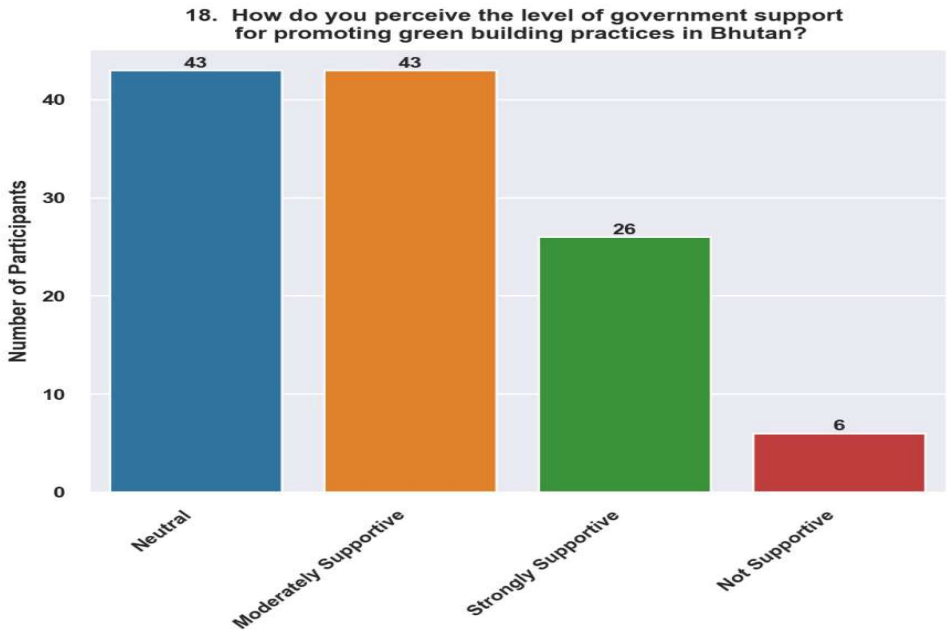

Figure 20. Different types of incentives to be needed to adopt green building in Bhutan.

Neutral (36.8%) (Figure 20). The neutral response may indicate the respondents' ambivalence or ambiguity about the government's degree of support for green construction efforts. This may be due to a perceived lack of overt measures or targeted policies aimed at sustainable building, or it can reflect the need for government officials to communicate and commit to encouraging green building practices.

To change this attitude, the Bhutanese government should make aggressive outreach and communication efforts to educate stakeholders about its green building-related laws, programs, and projects. This might demonstrate the government's commitment to sustainability and its efforts to assist green construction initiatives by publishing reports, holding stakeholder discussions, and participating in public forums.

Moderately Supportive (35.9%). The respondents' moderately supportive reaction suggests that while the government promotes green development, it may need to do more to meet expectations or thoroughly remove all obstacles. This impression can indicate better financial

incentives, more investment in capacity-building and awareness-raising initiatives, or more robust policy execution.

It is recommended that policymakers emphasize the creation and implementation of focused policies and activities aimed at speeding the adoption of sustainable construction methods and removing obstacles to improve government support for green building in Bhutan. Increasing financial incentives, fortifying legal frameworks, and funding training initiatives to elevate the skill levels of construction industry professionals are a few examples of how to do this.

Strongly Supportive (22.2%). The overwhelmingly positive response suggests that respondents favour the government's initiatives to encourage green building in Bhutan. This acknowledgment implies that stakeholders think the government is actively putting sustainability first and implementing practical policies to assist green building projects, the National Housing Development Corporation had already initiated sustainable construction in their ongoing projects. It might indicate contentment with current regulations, initiatives, or rewards meant to promote sustainability in the building industry.

This answer is positive, but it also presents a chance for the government to expand on its current initiatives and bolster its backing for green development even more. This could entail growing outreach and awareness efforts, scaling up successful programs, and working with stakeholders to pinpoint new opportunities and difficulties in sustainable construction.

Discussion of Respondence to Question No.19

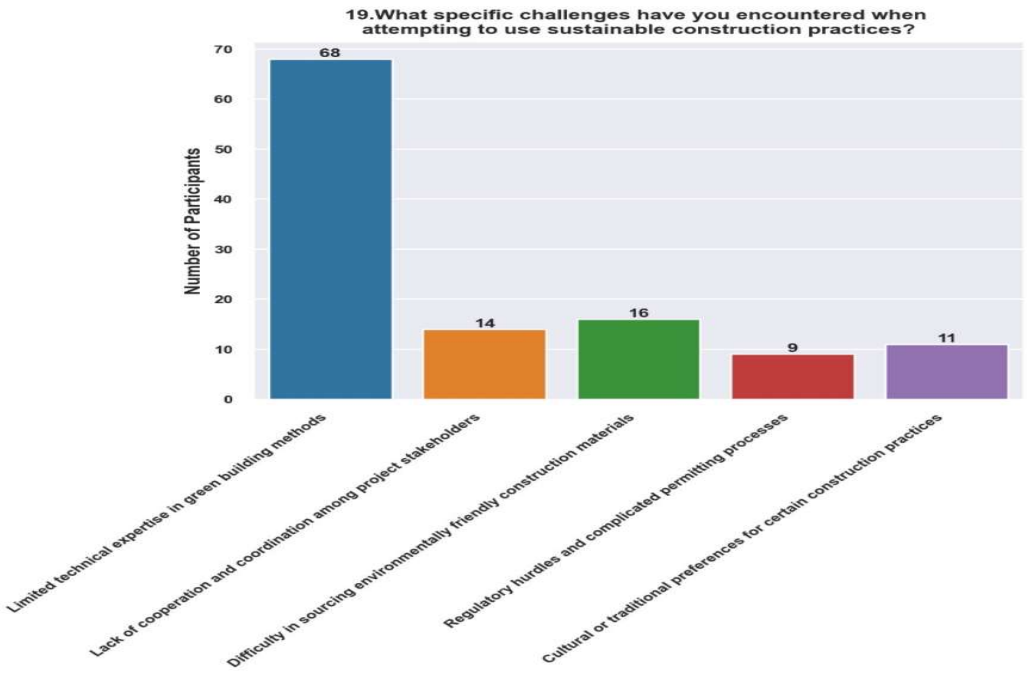

Figure 21. Different types of challenges faced to adopt green building in Bhutan.

Limited Technical Expertise in Green Building Methods (57.3%) (Figure 21). The prevailing lack of technical proficiency underscores the need for construction professionals to possess specific knowledge and competencies in green building techniques. Bhutan may need more professional training in energy-efficient technologies, green building regulations, sustainable design principles, and contractors. Investing in training and capacity-building initiatives to improve the abilities and expertise of those working on construction projects is necessary to meet this challenge. This could involve training programs, accreditations, and educational campaigns centered around sustainable building techniques, guaranteeing that experts possess the know-how to apply green building techniques successfully.

Difficulty in Sourcing Environmentally Friendly Construction Materials (13.7%). Difficulties locating eco-friendly building supplies highlight issues with sustainable building materials' accessibility, cost, and availability in Bhutan. Low local production capacity and conventional building methods could result in a limited supply of environmentally acceptable materials. To address this issue, the government might provide incentives for manufacturing and using locally sourced materials that comply with green construction standards. This could entail fostering eco-friendly manufacturing techniques, supporting the development of sustainable forestry methods, and pushing for alternative building materials like bamboo and rammed earth. Furthermore, cultivating alliances with manufacturers and suppliers might aid in increasing the market's accessibility to ecologically friendly building supplies.

Lack of Cooperation and Coordination Among Stakeholders (12%). In sustainable building projects, a lack of coordination and cooperation among project stakeholders can impede progress and lead to inefficiencies. Architects, engineers, contractors, government agencies, and other relevant parties must collaborate effectively to guarantee the integration of green building objectives throughout the construction process. The government can solve this difficulty through project management frameworks, regulatory processes, and stakeholder engagement programs by facilitating communication and collaboration. To ensure that sustainable building projects are effectively completed, obstacles to collaboration and coordination among project stakeholders can be removed with clear roles and duties, a culture of teamwork, and open communication.

Culture and Traditional Preference for Certain Sustainable Practices (9.4%). The adoption of sustainable building techniques in Bhutan is mainly hampered by the Impact of cultural customs and preferences on building practices. Local populations may have strong links to traditional building materials and methods, making it difficult or reluctant to embrace new ideas. Engaging with communities, increasing knowledge, and showcasing the advantages of sustainable construction methods in ways that respect and honour cultural traditions are crucial to addressing

this difficulty. This could entail emphasizing sustainable materials' financial and environmental benefits, incorporating traditional architectural features and aesthetics into green construction designs, and encouraging pride in regional ingenuity and craftsmanship. Bhutan may encourage a comprehensive approach to building by integrating sustainable construction techniques with traditional cultural values.

Discussion of Respondence to Question No.20

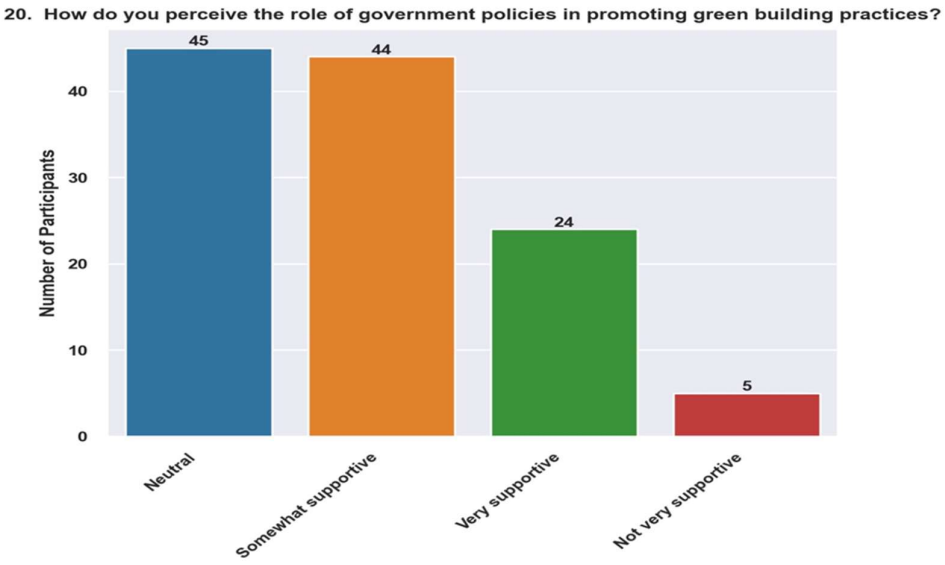

Figure 22. How government policy influence in promoting green building.

Neutral (38.5%) (Figure 22). The response indicates that no significant move from the government is entirely sure how well the government's present initiatives are working to promote green building techniques. This can result from a lack of knowledge of specific regulations aimed at sustainability in the building industry, or it might suggest a belief that current regulations need to be more robust and effective.

The Bhutanese government should make proactive outreach and communication efforts to educate stakeholders about its green construction policies and projects to rectify this image. This could entail promoting pertinent laws, rules, and incentives and showcasing best practices and successful case studies. Enhancing information accessibility and transparency might help the government gain stakeholders' trust and confidence in its commitment to advancing sustainability in the construction industry.

Somewhat Supportive (37.6%). The slightly supportive response indicates that even while the respondents accept the government's efforts to promote green building, they may believe that further steps or improvements are required to fully realize these policies' potential. This perception may stem from a desire for more extensive incentives,

stringent enforcement, or better alignment with national development goals.

To rectify this picture, the Bhutanese government can review and enhance existing policies to address gaps and tackle new difficulties in encouraging green building. This could mean reviewing policies, seeking input and recommendations from relevant parties, and, if needed, introducing new legislation or initiatives. The government can increase support by being flexible in response to stakeholder feedback and continuously improving policy frameworks.

Very Supportive (19.7%). The overwhelmingly affirmative response suggests that respondents have a favourable opinion of the role played by government initiatives in encouraging green building in Bhutan. This shows that those involved think the policies are successful, have an impact, and support national environmental preservation and sustainability goals.

This response is positive, but it also presents a chance for the government to expand its initiatives and fortify its green construction policy frameworks. Raising the bar for environmental performance in the construction industry could entail implementing new legislation or standards, growing incentives, and raising funding for sustainability projects. By leveraging the momentum of current support, the government may encourage further investment, innovation, and cooperation in green building methods, eventually furthering Bhutan's objectives for sustainable development.

The findings show that most Bhutanese people in the construction sector are moderately aware of sustainable construction. However, more than 55% of the respondents had never attended training or workshops even once within three years, which indicates that the government and NGOs need to work more to educate the people, particularly in the construction sector. Through awareness and education, the lifestyle and attitude of those people can be changed to reduce high CO_2 emissions.

Self-motivation and dedication are the keys to bringing about behavioural changes. Individuals and organizations are motivated to take action when they are satisfied with themselves and their ideals. Knowledge sharing must be maintained to inspire people to accept the new concept of green construction. As a result, construction stakeholders will learn about this new approach through execution and experience. Increasing the number of conferences, seminars, training, and workshops is advised to raise awareness. The public and private sectors must coordinate and collaborate to encourage and accelerate the green building movement.

According to the findings, most respondents believe that education is critical to accelerating the push toward putting green construction practices at the forefront of future projects. The low demand for green buildings reflected in these findings could also be attributed to the high initial cost of green technologies and materials. An improved

understanding of the benefits of green buildings could increase construction stakeholders' interest in incorporating sustainable techniques; however, most respondents believed that this could be best accelerated by providing government subsidies through low-interest loans for sustainable construction. Furthermore, construction businesses' senior management teams may communicate the benefits of green buildings to society and individuals and their long-term cost benefits, raising national awareness of the need for a sustainable construction model.

According to the literature, the government's role is critical in supporting green construction. Other change agents, on the other hand, may be equally important. Highlighting the change drivers is critical to understanding what factors push construction enterprises to apply green construction.

According to the findings, "education programs are viewed as the primary driver in accelerating the implementation of green construction in Bhutan". This is consistent with previous findings in this study, in which the educational element was recognized as the primary hindrance to lack of awareness. Knowledge programs are aimed at various stakeholders, expand general knowledge about green principles, and raise awareness and demand for sustainable construction processes. Understanding stakeholders is crucial because they are the primary decision-makers in choosing sustainable construction practices. However, the construction sector should lead in directing participants' attention to sustainability issues and educating them on the benefits of using sustainable and green practices.

The fourth driving reason, 'Economic incentives', is also a driving factor in supporting the sustainable movement. Demonstrates that financial incentives could assist stakeholders in stimulating demand. Financial incentives, as well as stricter laws and legislation, that support and encourage sustainable practices in construction standards and planning policy would provide a minimum level of equality across the industry. This should eventually offset the "higher cost" barrier.

Reported barriers to green building practice adoption

Respondents were asked to rank each element in terms of its importance as a barrier to implementing green building methods in Bhutan. The collected data was then examined and analyzed using the mean values. This is due not just to a need for more awareness, understanding, and concern for the environment but also to the belief that traditional methods of executing design, construction, and maintenance projects are adequate. In this regard, increasing knowledge through implementing an educational program in this sector would result in more experienced consumers demanding more efficient construction projects from the companies they work with, supporting sustainable practices.

Discussion of Respondence to Question No.21

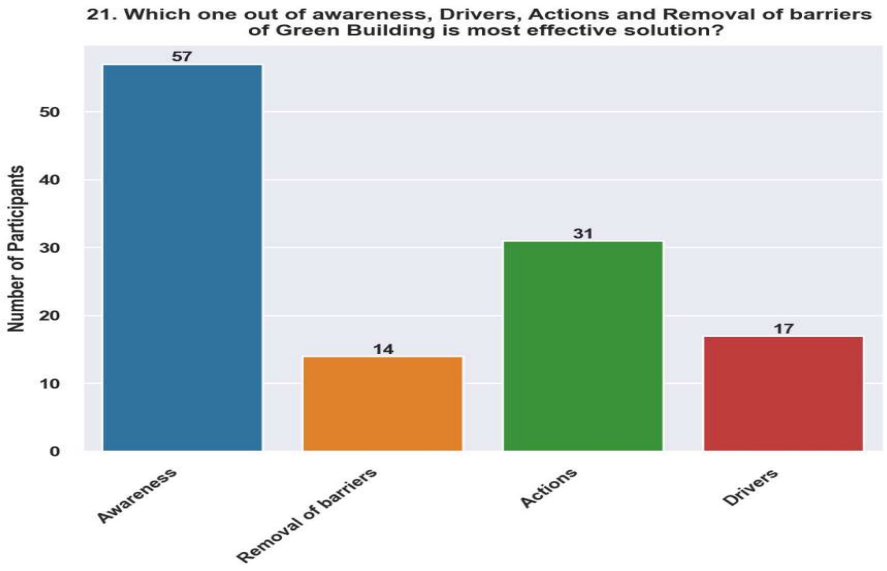

Figure 23. Description of content in this part of the figure.

Awareness (47.9%) (Figure 23). Awareness is the degree of knowledge and comprehension that people, communities, and stakeholders have about green construction's significance, advantages, and practices. In Bhutan, promoting green building practices means teaching people about the benefits of sustainable construction techniques in terms of the environment, society, and economy. This entails advocating for ideas like water conservation, energy efficiency, using renewable resources, and reducing carbon footprints in building design and construction.

Among the methods for raising awareness in Bhutan could be:

- Implementing educational initiatives that target multiple stakeholders, such as architects, engineers, policymakers, and the general public, through various mediums, such as workshops, seminars, and awareness programs.
- Incorporating green building principles into the curricula of universities, colleges, and institutions of vocational training.
- Collaborating with nearby communities, non-governmental organizations, and pertinent governmental bodies to distribute resources and knowledge on green building methods.

Action (26.1%). The term "actions" refers to the concrete measures people, groups, and governments have made to incorporate green building principles into building projects. Using waste management systems, implementing energy-efficient technologies, adopting eco-friendly building materials, and adhering to green building standards and certifications like the Green Building Council of Bhutan (GBCB) or the Leadership in Energy and Environmental Design (LEED) are a few examples of actions that can be taken in Bhutan.

They offer tax discounts, grants, preferential credit programs, and other incentives and subsidies for green building projects.

It creates and implements building codes and laws that require or reward sustainable building techniques.

Promoting the use of traditional Bhutanese building methods and concepts that emphasize harmony with the environment and nearby resources.

CONCLUSION AND FUTURE PERSPECTIVE

This study featured data obtained via a questionnaire as well as an analysis of the results [62]. The questionnaire's objectives were to investigate the level of awareness of sustainable and green practices among Bhutanese construction stakeholders, [63] to assess how active the respondents and their organizations were in the field of green construction, to assess the respondents' perspectives on key issues related to sustainable design, and to investigate the drivers and any barriers that may exist toward implementing the practice of green construction [64]. To accomplish these goals, the questionnaire was distributed to experienced stakeholders in Bhutan's building and construction industry [65]; 101 completed questionnaires were used for this portion of the study project [66].

The questionnaire data from the Google form was then directly taken to interpret based on the responses provided [67]. The findings revealed that a popular understanding of the idea of green building is aware among the people of Bhutan [68]. However, Greater awareness-raising efforts are still needed to speed the growth, adoption, and implementation of green building concepts in Bhutan [69]. Furthermore, the questionnaire findings suggested that green construction approaches are underutilized and that rules and regulations are needed as guidelines for satisfying the needs of both society and the environment [70]. To promote the green concept, the government could amend existing standards or enact new rules [71], as well as issue appropriate recommendations for the application of green practices to ensure that sustainable methods are used [72]. This will then motivate all stakeholders to make modifications to comply with the new legislation [73]. Cooperation between the commercial and public sectors is essential to guarantee that standards and norms are created in an appropriate and achievable manner so that the construction industry can adapt and implement the new legislation appropriately [74]. This necessitates an examination of the current impediments and the need to remove them so that the construction industry can transition and execute the new legislation with the least interruption and risk [75]. An investigation of the current legislation's application is suggested to address the 'lack of government enforcement' element, which respondents perceived as one of the existing causes for the lack of implementation of green construction technologies [75].

DATA AVAILABILITY

Below is the link shared that the response received, followed by the analysis for this research work: https://docs.google.com/forms/d/e/1FAIpQLSeEGSJJE-SenI855aw-YEAtzzjuHKLXdVWESqKlEp5PoPdV1Q/viewform?usp=sf_link.

AUTHOR CONTRIBUTIONS

Conceptualization, PKS and PC; Methodology, PKS and AKD; Software and Form Analysis, PC; Writing—Original Draft Preparation, PC; Review & Editing, PKS and AKD; Visualization and Supervision, PKS; Administration, PKS; Fund Acquisition, PC, PKS and AKD.

CONFLICTS OF INTEREST

The author declares that there is no conflict of interest.

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