USE OF NATURAL AND RECYCLED MATERIALS WITH MODERN AND TRADITIONAL SKILLS IN BUILDING CONSTRUCTION IN NEPALESE COMMUNITIES

Prakriti Dangol

A Dissertation

Submitted to
School of Education

In Partial Fulfillment of the Requirements for the Degree of
Master in Sustainable Development

Kathmandu University
Dhulikhel, Nepal

September 2024

AN ABSTRACT

of the thesis of *Prakriti Dangol* for the degree of *Master in Sustainable Development* presented on 26 September 2024 entitled *Use of Natural and Recycled Materials with Modern and Traditional Skills in Building Construction in Nepalese Communities.*

APPROVED BY

……

Ganesh Dhungana

Dissertation Supervisor

The study tries to understand the community's perspective on sustainability and their perceptions towards natural and recycled materials in building construction. The study conducted in Dhoksan, Kathmandu, Nepal, pinpointed key aspects the community considers when choosing building construction materials and the reason behind their perceptions. Furthermore, the study has highlighted both the pros and cons of natural and concrete materials. In addition to construction materials, the study also discusses the type of building construction with required skills, primarily focusing on traditional and modern skills. This qualitative research, along with the case study strategy, examines the value of traditional skills alongside modern ones in constructing environmentally and financially beneficial buildings in communities in Nepal. The findings reveal that people in Dhoksan value the natural benefits of natural materials, but the concerns about durability and maintenance persist. Traditional skills are appreciated for their cultural and thermal significance. Yet, modern techniques are often preferred for their efficiency, suggesting a need for better awareness and integration of both traditional and modern methods for sustainable development. The findings could help architects, social workers, and community developers understand sustainable and community-driven building approaches. The integration of sustainable education, aided by indigenous knowledge exchange and modern architectural competence, emphasizes its transformative impact.

……. 26 September 2024

Prakriti Dangol

Degree Candidate

सोध सार

१० असोज २०८१ मा प्रस्तुत गरिएको दिगो विकासमा स्नातकोत्तर डिग्रीको लागि प्रकृति डंगोलको शोध प्रबन्ध नेपाली समुदायमा भवन निर्माणमा आधुनिक र परम्परागत सीपहरू सहित प्राकृतिक र पुनः प्रयोग गरिएको सामग्रीको प्रयोग।

.....

सोध निर्देशक हस्ताक्षर

अध्ययनले सामुदायिक दृष्टिकोण र भवन निर्माणमा प्रयोग गरिएका प्राकृतिक तथा पुनःप्रयोग सामग्रीहरूको महत्त्वलाई बुझ्नका लागि प्रयास गरेको छ। काठमाडौँको धोक्सान क्षेत्रमा गरिएको यस अनुसन्धानले भवन निर्माण सामग्रीप्रतिको समुदायको धारणा, तिनले महत्त्व दिनेका पक्षहरू, र सामग्रीप्रतिको रुचिका कारणहरूलाई उजागर गरेको छ। साथै, अध्ययनले प्राकृतिक र कंक्रीट सामग्रीका फाइदा र बेफाइदालाई पनि स्पष्ट रूपमा देखाएको छ। यसमा, विशेष रूपमा परम्परागत तथा आधुनिक सीपहरूमा ध्यान केन्द्रित गर्दै, भवन निर्माणको लागि आवश्यक सीपहरू र निर्माणका प्रकारहरूको बारेमा पनि अध्ययन गरिएको छ। गुणात्मक अनुसन्धानको यो दृष्टिकोणले केस स्टडी र रणनीतिहरूको माध्यमबाट नेपालका समुदायमा वातावरणीय तथा आर्थिक रूपमा लाभदायक भवन निर्माणमा परम्परागत सीपहरूको भूमिका र मूल्यलाई जाँच गरेको छ, जसलाई आधुनिक सीपहरूसँग एकीकृत गरिएको छ।

धोक्सानका स्थानीय बासिन्दाहरूले प्राकृतिक सामग्रीका जैविक फाइदाहरूको कदर गरे तापनि, स्थायित्व र स्रोत-संरक्षणको चासो कायम रहेको निष्कर्ष निकालिएको छ। परम्परागत सीपहरूलाई सांस्कृतिक र स्थानीय महत्त्वका दृष्टिले प्रशंसा गरिएको छ, तर दक्षताका कारण आधुनिक प्रविधिलाई प्राथमिकता दिइने गरेको पाइयो। यसले दिगो विकासका लागि परम्परागत र आधुनिक प्रविधिहरूको समुचित समन्वयको आवश्यकतालाई स्पष्ट रूपमा संकेत गर्दछ। यस अनुसन्धानले वास्तुकला, सामाजिक कार्यकर्ता, र सामुदायिक विकासकर्ताहरूलाई दिगो र समुदाय-सञ्चालित भवन निर्माण दृष्टिकोणहरू बुझ्न मद्दत गर्नेछ। दिगो विकासको एकीकरण, स्वदेशी ज्ञानको आदानप्रदान, र आधुनिक वास्तुकला क्षमताको सहयोगले यस क्षेत्रको विकासमा रूपान्तरणकारी प्रभाव ल्याउन सक्छ।

..... १० असोज २०८१

प्रकृति डंगोल
उपाधि उम्मेदवार

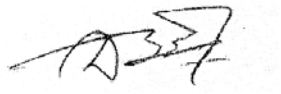
This dissertation entitled *Use of Natural and Recycled Materials with Modern and Traditional Skills in Building Construction in Nepalese Communities* presented by*Prakriti Dangol*on*date of viva voce.*

APPROVED BY

……... 26 September 2024

Ganesh Dhungana

Dissertation Supervisor



……... 26 September 2024

Durga Prasad Baral, PhD

External Examiner

……... 26 September 2024

Asst. Prof. Suresh Gautam, PhD

Head of Department

……... 26 September 2024

Prof. Bal Chandra Luitel, PhD

Dean/ Chair of Research Committee

I understand that my thesis will become a part of the permanent collection of the library of Kathmandu University. My signature below authorises the release of my dissertation to any reader upon request for scholarly purposes.

……. 26 September 2024

Prakriti Dangol

Degree Candidate

DECLARATION

I hereby declare that this thesis is my original work, and it has not been submitted for candidature for any other degree at any other university.

…….. 26 September 2024

Prakiti Dangol

Degree Candidate

ACKNOWLEDGEMENT

I am indebted to my supervisor, Ganesh Dhungana, for guiding me in framing the research questions, conducting fieldwork, synthesizing the collected data, and concluding the research work. I owe him a huge thanks for his patience with me and his motivation to give my best in this thesis. I am also thankful to Nisaz Shrestha, who helped me connect with the architects during my research study. Likewise, I express my sincere appreciation to the local workers, both skilled and unskilled, from the village working on the project, who shared their construction knowledge and practices with me. Finally, I pay my deepest gratitude to 'EFFORT: Enhancing Livelihood and Fostering Resilience among Vulnerable Communities along Trishuli River Basin Project,' implemented by Action Nepal and DCA, for providing a grant to conduct this research.

Prakiti Dangol
Degree Candidate

TABLE OF CONTENT

ABBREVIATIONS

3R	Reduce, Recycle, and Reuse
CGI	Corrugated Galvanized Iron
DRRMA	Disaster Risk Reduction Management Authority
DRRNSPA	Disaster Risk Reduction National Strategic Plan of Action
KII	Key Informant Interview
KVERMP	Kathmandu Valley Earthquake Risk Management Project
NAPA	National Adaptation Program of Action
NCC	National Climate Change
NPR	Nepali Rupees
NSET	National Society for Earthquake Technology
NUDS	National Urban Development Strategy
RCC	Reinforced Cement Concrete
SDGs	Sustainable Development Goals
SWMA	Solid Waste Management Act

LIST OF FIGURES

LIST OF TABLES

CHAPTER I
INTRODUCTION

Buildings consume 40 % of the world's annual energy (Omer, 2008), 25% of water, and 40% of global resources contributing to carbon dioxide emissions, soil erosion, water pollution, and floods (Cooper, n.d.). Data shows that the construction industries contribute 10% to the European Union's Gross Domestic Product (GDP), provide 18 million jobs (Zhao et al., 2019), meet population needs, consume 50% of raw materials and 36% of global final energy (Pérez-Lombard et al., 2008;Allouhi et al., 2015). This consumerism negatively impacts the environment. It is a key challenge to developing a sustainable living relationship between humans and nature.

Moreover, the sustainability of a building is significantly influenced by the design and construction decisions made early in its life, as the operation, maintenance, and disposal all consume matter and energy (Chan et al., 2017). The limited life of construction products makes renovation and deconstruction crucial for environmental sustainability. Deconstructed materials can be recycled and reused, reducing the need for new resources. Hence, the circular economy can significantly impact the construction industry and the built environment (Mavi et al., 2021). It is important to reduce environmental and health implications by employing sustainable construction techniques. Thus, there is a need to focus on sustainable design, materials, and procedures to drastically reduce pollution and resource consumption, which will contribute to building a healthier and more sustainable future as envisioned in the Sustainable Development Goals (SDGs) of 2030. By 2030, the SDGs aim to end pollution and reduce the industry's environmental impact by promoting and adopting sustainable practices.

In today's construction industry, natural and recycled materials appear to be a potential option for reducing or minimizing construction's environmental footprint. Additionally, building professionals are seeking greener solutions as an effective method to decrease environmental impacts. This technique uses minimally processed resources such as wood, bamboo, straw, adobe, cob, rammed earth and stone, recycled bottles, plastics, and scrap wood(Turan, 2015). Furthermore, it promotes earth-based building techniques, such as rammed earth, adobe, lime plaster, cob, wattle, and daub, which are gaining traction. Adopting these materials in building envelope applications

can help improve in-use energy efficiency and have a low environmental impact. Earth walls are not just about the thermal insulation but their high thermal inertia, the ability to store and manage heat. The advantage of being renewable and low embodied energy contributes to global sustainability (Nasr et al., 2023).

The study explores how adopting natural and recycled construction materials, and applying traditional skills alongside modern ones can be beneficial environmentally and financially for communities residing in suburban and remote areas in Nepal.

Statement of Problem

Nepal faces challenges in transportation issues due to remote areas and hilly terrain, causing increased fuel consumption and decreased thermal efficiency(Heyns & Banick, 2024). This is also responsible for contributing to 23 percent of global emissions, with 5.7 billion tons of carbon dioxide emissions in 2009 (Sizirici et al., 2021). Likewise, landslides, heavy rainfall, and intense cold hindered the transportation of materials, particularly those transported by animals and human porters, mostly on rainy days; transportation of materials like cement had to be stopped to ensure they remained dry and fit for use (Manavazhi & Adhikari, 2002). This reflects a general lack of awareness regarding the possibilities for cost savings and environmentally friendly local and recycled materials for building construction. Because of the community's lack of understanding and ignorance, people are choosing imported construction materials massively depending on expensive external labor and transportation instead of utilizing these locally available natural and recycled resources to build their houses. Hence, it is essential to study the adaptation of local materials, which has the potential for recirculation and adaptation of circular economy in construction sectors (Manavazhi & Adhikari, 2002).

In addition to financial and environmental benefits, using traditional knowledge and natural materials also has multiple benefits, such as being more resistant to earthquakes. For example,Dixit et al. (2004)identify the ways through which building stability against earthquakes is maintained and applied by traditional knowledge. Similarly, even buildings traditionally built using local materials can be reinforced by considering the design strategies needed for traditional buildings (Shrestha & Singh, 2019). However, the traditional method has been impacted and is at risk of disappearing due to the increased usage of concrete and the arrival of new technology.

However, most community members are still doubtful about the traditional approach of building construction regarding their perceived safety and resilience. Traditional buildings are often demolished due to factors like age and low maintenance (Gyawali et al., 2016). There is a massive knowledge gap regarding the scientific validation of traditional skills and the use of natural materials in the construction industry. Therefore, it is imperative for the Nepalese government to conduct a thorough analysis of those practices, implement the current policies on earthen construction effectively, conduct additional research on natural materials and recycled construction, and encourage the use of practices that support affordable and environment-friendly building methods.

Research Purpose

The main purpose of the study was to explore approaches using natural and recycled construction materials in the communities in Nepal. In doing so, the study also aimed to examine the value of traditional skills alongside modern ones in constructing environmentally and financially beneficial buildings in communities in Nepal. The specific objectives of the study are as follows:

1. To understand the sustainability of using natural and recycled materials in building construction through a local perspective.
2. To analyze how local skills and knowledge are incorporated in sustainable building projects in Dhoksan, particularly employing natural and recycled materials.

Research Question

The study aims to answer the following research questions.

1. How do local people perceive natural building and recycled materials in construction?
2. What skills and knowledge related to the building construction are prevalent among the local communities?

Significance of the Study

One of the criteria for achieving quality research is developing a topic that is worthy. A worthy topic means a topic that is appropriate for the current period and can be contextualized to the contemporary environment. Choosing the appropriate topic can generate significant value for the audience or readers, and with the insight of the research, differences in society can be witnessed. Except for a few organizations like Lumati that I have come across in Nepal, which uses the participatory method to

build housing projects for slum settlements, the construction sector seldom uses it. The natural building construction, which might be a game-changing adaptation in the building process, is rarely documented. This study will help architects and community members understand how the technique might be replicated in various village models where transporting building supplies is difficult. This also aids in understanding the people's perceptions of sustainability, the problems associated with introducing new materials, and the success of such introductions. Furthermore, the study can help in understanding its impact on social, economic, and environmental aspects while promoting sustainability within communities and among individuals.

Scope and Limitations of the Study

The study focuses on using natural and recycled construction materials together with traditional and modern building construction methods, stressing the environmental and financial benefits to Nepalese communities. It looks at Dhoksan village in Shankarapur Municipality Ward number 5 and Benighat Rorang Rural Municipality in Dhading, which were chosen for their similar environmental, social, and economic characteristics. The research examines natural and recycled construction materials, specifically highlighting resources like wood, bamboo, straw adobe, cob, and rammed earth alongside recycled materials such as bottles, plastics, recycled bottle caps, and wood. The study explores how combining modern and traditional skills with natural and recycled materials promotes sustainable building practices. It also aims to comprehend the role of involvement in integrating these resources using traditional and modern abilities, which can benefit the economy, society, and the environment.

However, as the study has documented the case of Dhoksan village, the conclusions may be limited in their applicability to other regions of Nepal with differing environmental, social, and economic factors. The participants' subjective experiences and perceptions have been widely documented in the study and,might have been influenced accordingly. The introduction of new materials and improved training and guidance on using recycled materials are certainly required. Furthermore, the underdeveloped recycled and natural materials market requires significant investment to establish dependable supply chains and relationships. In addition, environmental factors such as seasons, high rainfall, and extreme cold might have impacted the study's findings. Finally, while the study argues that the Government of

Nepal should endorse and promote sustainable practices, real implementation of such regulations remains a challenge.

Organization of the Thesis

The study's outline is structured into six extensive chapters, each addressing a separate but connected aspect of the investigation. Chapter I provides an introduction that sets the tone of the research report by highlighting the environmental challenges confronting the building industry and the need for sustainable construction methods. It further provides problem statements, research questions, objectives, significance, scope, and study limits. Chapter II evaluates existing studies on sustainable construction, traditional and modern skills, community participation, and policy in Nepal. Similarly, Chapter III discusses the methodology, which explains the study design, data collection methods, and data analysis procedures. Chapters IV, Chapter V and Chapter VI contain the findings, discussion, and conclusion of the study.

CHAPTER II
LITERATURE REVIEW

The literature review chapter explores literature to understand natural building materials in sustainable building construction methods. It has documented the literature on the historical use of materials like mud, stones, timbers, adobe, and straw bales in building construction. The chapter has also explored the ability of natural materials to improve the thermal and aesthetic features of buildings, ensuring the essence of the traditional architectural approaches. Further, the chapter has also investigated the current state of natural and recycled materials in Nepal's construction industry and has presented the findings of literature to understand the role of natural and recycled materials in supporting sustainable practices and understanding the relationship between legacy, culture, and environmental care in construction.

Natural Construction Materials

Natural materials are locally available resources that are commonly employed in the construction of homes. Traditionally, buildings were built of mud, stones, timbers, slates, straw, and adobe, all available locally as natural materials. These materials serve as structural, insulating, and complementing materials. Structural materials such as wood, stone, rammed earth, straw bales, clay bricks, and adobes (Dethier & Clarke, 2020) are used for load-bearing masonry, while adobes are capable of creating arches, vaults, and domes. Likewise, insulating materials like sheep wools, fibers, hemp, cork and clay in the form of plastering, painting, and flooring (Spišáková & Mačková, 2015). Additionally, a hybrid structure often combines wattle and daub with a load-bearing wooden framework (Dethier & Clarke, 2020). Using locally available natural materials supports sustainable building practices, preserves traditional architectural techniques, and enhances the structural, thermal, and aesthetic qualities of residences.

One particularly significant natural material in this context is earth, an inexpensive and locally accessible building material used since ancient times. It has been used as a raw material or fired to produce ceramic bricks; more than one-third of the human population lives in earth-based buildings (Minke, 2021;Pacheco-Torgal & Jalali, 2012). For instance, rammed earth construction, a popular and inexpensive

energy source, dates back to 2600 BC and has been used in structures like the Great Wall of China, the Alhambra in Spain, and the Pyramid of the Sun in Mexico (Frangedaki et al., 2020). Earthen buildings are often found in rural areas of developing countries (Ciancio et al., 2013;Pacheco-Torgal & Jalali, 2012). Raw earth techniques offer significant benefits despite their labor-intensive nature and need for periodic maintenance. It does not require industrial processing and requires minimal transportation, eliminating the need for fossil fuel and CO2. Earth is 100% recyclable when used without cement or other industrial additives and provides thermal comfort, maintaining indoor temperatures opposite to outdoor extremes (Dethier & Clarke, 2020).

Recycle Materials

Sustainable construction has been an important topic among researchers since the late 1980s (Bakhtiar et al., 2008). The practice involves utilizing the resources efficiently through ecologically based principles for creating a healthy environment and sustainable construction, as highlighted at the first international conference on sustainable construction in 1994 in Tampa, Florida (Kibert, 2007). Similarly, the way of tackling the negative environmental impacts is by using recycled materials such as road bases made from removed crushed concrete drywall made of recycled newspaper. Recently, there has been an increase in the use of recycled glass, plastic, paper, and metals (Burnard et al., 2015).

Recycled materials are essential for sustainable building because they extend the life cycle of resources, decrease resource exploitation, and reduce waste creation. This technique is consistent with continuous reuse of materials, where instead of throwing away, materials are recycled and reused in new projects (closed loop systems), in which materials are continuously reused, decreasing the need for new energy-intensive construction and lowering environmental impacts(Skowronski & Charytonowicz, 2010).Plastic waste, in particular, is adaptable, making it a valuable material in construction. For instance, polyethylene terephthalate (PET) bottles with sand or soil are used by low-income communities to create bricks for housing and have gained traction (Muyen et al., 2016). Additionally, plastic waste is now being integrated into concrete, with research demonstrating its effectiveness as a reinforcement material alongside traditional steel rebars (Pešić etal., 2016).

One thousand and five hundred billion bricks are produced globally every year, of which 1300 billion are from Asia (Aneke & Shabangu, 2021). These

produced bricks absorb carbon dioxide after firing, contribute to a harder final product, and further increase carbon footprint.

Traditional Building Construction in Nepal

Nepal consists of 83 percent of the rural population, and about 90 percent of the total houses in Nepal are non-engineered construction, which depicts the wider presence of vernacular non-engineered buildings (Gautam, et al., 2016a). This wide use of traditional techniques reflects a rich architectural heritage that has evolved over centuries, adapting to Nepal's diverse geography and cultural tapestry.

Nepal's architectural history has been shaped by multiple separate eras comprising the diverse array of building styles currently on display. The Licchavi Period, which spanned 400–750 CE, brought religious structures and stone sculptures that helped establish the foundation of the iconic pagoda design. Nepalese architecture peaked during the Malla Dynasty (1201–1769 CE) when the unusual Newari style—characterized by incredibly ornate palaces and temples in the Kathmandu Valley—became predominant. The Newari and Gorkhali architectural styles were incorporated during the Shah Dynasty (1769–2008 CE), followed later by British colonial architecture. This development is consistent with Nepal's dynamic cultural legacy and its adjustment to the shifting socio-political environment over the centuries.

Nepal is geographically diverse, with its three regions – Terai, Hilly, and Himalayan – that use different materials for building construction based on local availability. The Terai region is characterized by coarse, gravel, and finer sediments, with rich alluvial soil providing fertile agricultural land and dense Sal Forest, allowing abundant wood, thatch, biogenic material, mud, and sand for house construction. In the Hilly region, construction materials like stones, soil deposits, sand gravel, and dense vegetation like Sal or hill forests are used for building construction. Large valleys like Kathmandu use lacustrine soils for brick-making, while river beds provide sand and gravel. Plenty of stones, boulders, and mud materials are available in the Himalayan Mountains. Timber and other organic materials for building purposes are somewhat scarce because of the limited availability of fertile soil and the harsh climate (Bodach et al., 2014).

The traditional architecture in Nepal adapts its design to the climate of the region. It uses local materials and craftsmanship that represent the culture, customs, and lifestyles of the local community (Chandel et al., 2016). Reaching the high-altitude settlement area from the closest motorable road takes many days. Snow

blocks the routes during the winter. The topography of Nepal makes it difficult to transport construction materials and makes it more expensive in many areas (Bhochhibhoya et al., 2017). Hence, utilizing natural resources or locally available materials has been important due to different geographical terrain in different regions.

Traditional Nepalese architecture is a result of a rich tradition of knowledge and skill passed down through generations. Master carpenters, known as Sikarmi, and stonemasons, known as Dakarmi, are key to practicing and advancing these techniques. These skills are passed down through apprenticeship programs, ensuring their existence and continuance. Most of these skills are learned from their fathers and families(Parajuli, 2012) ensuring the preservation of Nepal’s architectural heritage and the country’s effective construction methods.

Since architecture plays a significant role in both culture and religion in Nepalese society, buildings are intimately associated with ceremonies and rituals. Korn (1976) says that "extensive rituals and ceremonies, to ensure property, health and wealth from the gods and goddesses as well as their protection" were a part of the city's establishment (p. 11). However, according to Gray, (2011), when a house is being built, several intricate rites must be followed, from the choice of the site to the inauguration, to ensure auspiciousness for the owner's harmony with the home and the cosmic order. These rites include Rudri Puja, which dedicates the finished house, Jag Puja, which asks the ground deity for permission to ensure that the land is spiritually suitable for construction, and Bhumi Puja, which asks for permission from the earth deity before any construction begins, ensuring the site is spiritually and physically auspicious for building.

The way that person, place, and time are integrated into Nepalese architectural traditions is further poignantly enhanced by the astrological timing of the auspicious period for construction and other initiation rituals. These kinds of cultural integrations permeate every facet of construction, from military fortifications to ornamentation and architectural planning at the commencement of development. In fact, according to Korn (1976, p. 14), the custom of "setting up guardian lions at entrances and performing religious rites to protect the buildings against enemies" is still observed today. Such a marriage of ritual and workmanship attests to Nepal's rich architectural past while enhancing structural integrity and cultural authenticity.

Despite their cultural significance, traditional building practices in Nepal face several challenges. Traditional buildings performed poorly compared to modern

reinforced concrete structures (Romão et al., 2015). According to Bothara et al. (2016), the houses that suffered damage during the earthquake were not engineered and were primarily constructed using poor masonry, burned brick, dry stone, stone in mud mortar, and reinforced concrete.

Building construction styles in Nepal have altered as a result of economic liberalization, remittances from Nepalese people working abroad, increased road network accessibility to construction supplies and technology, and cash input from these sources. The process has been aided further by the decision to expand the building vertically due to factors such as rising land costs and increasing urbanization(Bothara et al., 2016).

An extremely significant, centuries-old architectural history is represented by traditional Nepalese construction. Such practices, which suffered throughout the modern traditional period, continue to be of great cultural concern and offer an important lesson in appropriate and proper environmentally adaptive architecture. The future will likely include the integration of modern and traditional knowledge with appropriate engineering to create structures that are both structurally sound and culturally appropriate. Preserving different cultural and environmental adaptations could address the risks of traditional buildings that were previously mentioned.

Debris as Recycled Materials for Construction

It is possible to efficiently extend the life of a building product by utilizing stronger and recyclable materials. Reusing construction materials from demolished buildings in newly constructed structures is one smart strategy. This strategy can be implemented through the disassembly design concept (Minunno et al., 2021). This strategy gained particular relevance after the massive 2015 earthquake in Nepal, highlighting the potential for recycling to prevent the depletion of natural resources and undesirable transport of materials and protect the environment from degradation (Ehler & Shrestha, 2015).

The concept of reusing waste was established when farmers often generated a large amount of straw waste used in the construction process. In rural regions, organic agricultural waste like cow dung has been used to reinforce mud and avoid fractures (Lekshmi et al., 2020). This knowledge is still applicable today. It is essential to think about creating hybrid construction methods that enable the benefits of all currently used construction techniques to coexist: the traditional technique for its insulating power and ecological and bioclimatic aspects and the modern technique for its

effective mechanics and economic viability(Belabid et al., 2023). Building components designed to be constructed and reused for the second life have been linked to reductions of up to 81 percent in embodied energy and 88 percent in embodied carbon (Minunno et al., 2021). Within the present scenario of sustainable development, demolition waste ought to be investigated in several domains, such as enhancing soil strength (Das & Bharali, 2022) and utilizing demolition waste in building environmentally friendly structures (Bharali et al., 2021). However, the Nepal government failed to manage the accumulated concrete/ brick debris properly.

Nonetheless, it is essential to manage the debris and waste after the disaster. However, the government of Nepal and its agency National Reconstruction Authority (NRA) have not paid enough attention to its implementation. Not enough studies focus on the generation of the debris generated from earthquakes and construction waste produced during housing reconstruction (Bharali et al., 2021).

The main challenges in developing countries for disaster waste management are the unavailability of relevant policy frameworks, coordination among relevant government levels and departments, stakeholder engagement, and lack of financial and technical capacity. Waste management often focuses on municipal waste, neglecting construction, demolition, and disaster waste, which is poorly defined in national and local policies (Memon, 2015). Hence, the policy framework for waste management should be improved with clear definitions of construction and demolition for waste management with clear definitions of construction.

Legislative Provision of Building Construction

The absence of strong environmental policies in construction has led to uncontrolled and haphazard urban sprawl, exacerbated by political instability and frequent government changes, despite including sustainable building techniques in Nepal's National Urban Development Strategy and the National Adaptation Program of Action. Bhattarai et al. (2023)highlight that the current policy on earthquake-resistant building construction advocates for sustainable methods. However, it lacks explicit mention of "green building" concepts, although it does recommend using locally accessible materials like Compressed Stabilized Earth Blocks (CSEBs) and fly ash bricks, which have a lower carbon footprint compared to steel and cement. A policy framework emphasized the calls for steps such as financial incentives for eco-friendly construction methods, the creation of eco-friendly building codes, the promotion of eco-friendly building certification, and the establishment of a green

building fund. These measures aim to motivate builders and encourage adopting sustainable building practices, including providing green building funds to offer loans and grants for sustainable building advancements.

The Asian Development Bank responded to the 2015 earthquake with a "build back better" framework, introducing policy measures to promote resilient and sustainable natural building materials. The key initiatives included

1. the local builder technical support and a training program for local buildings, utilizing performance-based building codes as another important policy measure
2. prioritizing energy-saving green construction practices like passive solar heating and cooling
3. initiating the natural building materials, and collaborating with the neighborhood groups.

Despite these efforts, implementing sustainable building techniques remains inconsistent, as building codes and national strategies often fail to enforce these methods effectively (Government of Nepal, National Planning Commission, 2015). In Nepal, the guidelines are not strict. Even though only a few materials are stated in the construction rules, they are not developed in detail, which presents a challenge to the experts.

The table with the information on laws, acts, and regulations of the construction of the building in Nepal, prepared by the researcher based on the literature found is inserted in the appendix.

Traditional Skills of Building Construction

Traditional skills refer to local people's notions and cultural understanding of local people’s way of life(Ingold & Kurttila, 2000). This knowledge is part of the people’s cultural heritage and the histories of local communities. They help develop low-cost, organic, and eco-friendly products that benefit communities and the environment (Mety et al., 2022). Thornton and Herrero (2015)believe that traditional and community-based may teach us a lot about solving communities' evolving problems. These techniques, which have their roots in local expertise and knowledge, can provide insights into flexible and long-lasting answers to contemporary problems. Individuals conduct experiments and conclude experiences, blending traditional knowledge with science and technology through continuous experimentation, innovation, and adaptation, fostering a more holistic understanding of knowledge (Audefroy, 2011). Therefore, one of the most effective and long-lasting ways to

address new environmental and economic problems in the community may be to integrate alternative evidence-based knowledge systems into established ones.

Collaboration learning is a social contract between peers or between peers and the teacher. The cooperation contract implicitly requires both the learners to contribute to the solution (Dillenbourg, 2007). Local resources and acquired knowledge related to the local culture enabled development routes that evolved to meet productive and economic problems (Vázquez-Barquero & Rodríguez-Cohard, 2019). Hubka (1979) explores the study methods of folk builders in traditional building production, which are passed down through word of mouth, replication, and apprenticeship. This ensures the continuation of local building traditions by passing knowledge from masters to apprentices. The cultural expression found in the traditional structures has been carried into the present day in these settings, particularly through the mentorship relationships between master craftsmen and apprentices.

Construction is traditionally considered a profession with male-gendered social structures and a focus on technical abilities, whereas women associate better with the social area of construction (Madikizela & Haupt, 2010). This gender stereotyping poses a significant challenge in the industry, as men predetermine the culture. Women often assume traditional and administrative roles, making survival difficult in the sector. Gender-based discrimination creates an economic disadvantage for women and has a significant influence on their employment (Nguyen & Tarp, 2022).

The importance of educational and training programs lies in their ability to revive the link between master and apprentice and transfer the expertise of builders to future generations through an applicable method. Training programs are crucial in preserving and adapting traditional building techniques to contemporary needs (Fien & Winfree, 2014). Such programs can transfer traditional knowledge from experienced artisans to younger generations in schools, ensuring the continuity of valuable skills and practices (Mpofu & Miruka, 2009). Hence, supporting such education initiatives can help sustain traditional crafts and integrate them with modern innovations for a balanced approach to construction.

Modern Skills of Building Construction

Workers face new challenges in managing new materials and machinery risks, such as glass and plastic tiles. Maqbool et al. (2023) highlight the importance of

proper training on equipment handling and the use of advanced safety gear, such as wearable devices, is essential to prevent injuries. (Volkov & Tuskaeva, 2017) also highlight that the new machinery can improve efficiency and safety while working in construction. Hence, the new approach to using new materials to reduce environmental impact requires focusing on safety measures.

Participatory intervention involves full-scale experimentation, including building prototypes for services and creating larger spaces (Royer, 2022). Prototyping is crucial for communicating and aids designers in expanding or contracting possible concepts. Chou & Austin-Breneman (2018) highlighted the difficulty in finding locally available products suitable for adaptation during prototyping. On-site modifications are also essential for reducing design fixation. Physical models at a 1:1 scale and detailed drawings can facilitate understanding and reduce error in design (Dadi et al., 2014). However, on-site workers stated that creating prototypes can be time-consuming and expensive.

Architects share their expertise, perspectives, and ideas, allowing exchange of knowledge (Zamiri & Esmaeili, 2024) and leveraging local resources for economic development (Vázquez-Barquero & Rodríguez-Cohard, 2019). This collaboration facilitated education on natural and recycled materials, laying the groundwork for future community development initiatives, and laying groundwork for future community development initiatives (Braun & Okwako-Riekkola, 2018; Xu et al., 2019). However, some recycled materials, such as date oil palm, sewage sludge, citrus peels, soy bean, animal fat, polyester lumber, rice husk, and swine manure, are poorly documented and underused. New research and government-approved regulations are needed to track their underusage and improve community development initiatives (Bolden et al., 2013).

Modern Building Construction in Nepal

The city of Kathmandu is home to vernacular homes arranged along small streets and in the vicinity of public squares, as well as brick and timber palaces and temples with tiers. Conversely, houses in rural settlements on steep mountain slopes are typically closer to the rice fields where they get food and are haphazardly built and arranged following the terrain’s natural contours (Forbes, 2018).

Traditional building methods, such as using timber ties on all four walls to resist earthquakes, are being forgotten as new cement-concrete construction methods become more popular (Dixit et al., 2004). An elderly craftsman ‘Karmi’ noticed

similarities between the National Society for Earthquake Technology- Nepal (NSET) engineer's insistence on a 'tie band' around masonry structures and his grandfather's preaching(Dixit et al., 2004). Using timber ties on all four walls has been misunderstood and reduced to ritual, leading to a significant decrease in earthquake resistance in modern buildings. The National Society for Earthquake Technology's (NSET) School Earthquake Safety Program (SESP) highlights the need for better earthquake safety practices. Unfortunately, this traditional knowledge has been reduced to ritual rather than being understood as a critical part of earthquake resistance, leading to a decrease in the structural resilience of modern buildings.

Earthquakes have profoundly influenced building practices in Nepal. There was extensive damage during the 2015 Gorkha earthquake, especially to non-engineered construction like adobe and unreinforced masonry. According to Gautam et al. (2016b), many of these were constructed without considering seismic resilience, which resulted in serious structural failures (Gautam et al., 2016b). The Kathmandu Valley Earthquake Risk Management Project (KVERMP) and other similar initiatives highlighted the urgent need for seismic resistant construction techniques.

As a result of these vulnerabilities, a noticeable shift toward cement-based and reinforced concrete constructions occurred in Nepal. These modern construction materials and techniques, seen as more resilient against earthquakes, began replacing modern traditional methods. These modern building materials became favored due to their ability to provide higher resilience, better load distribution, and flexibility during seismic events, which is critical for reducing casualties and damages in future earthquakes.

In rural areas, most people are farmers, and traditionally, they use organic manure as a fertilizer at home, where humans excrete manure in the field (Sciences, 2017) and are concerned about the transfer of diseases (Usman et al., 2012). The decline of phosphorus deposits worldwide (IFDC, 2010; Granthum, 2012) has also rejuvenated the concept of recycling human excreta as a phosphorus source(Starck et al., 2024). In today's context, compost toilets fit sustainable construction since they reduce water and wastewater flows within the buildings (Anand & Apul, 2014). Nonetheless, there are other obstacles to composting toilets in urban environments, such as a lack of knowledge and expertise in composting toilet design and operation as well as program operation, laws, and public acceptance (Anand & Apul, 2014). Additionally, a number of initiatives are encouraging the recycling of human urine to

make compost. Traditional skills of using the manure as a compost toilet lead to growing good vegetables on farms, providing nutrients for crops, and minimizing the risk of weeds and land degradation (Zhu et al., 2021).

Nepal's architectural history demonstrates the shift from traditional, natural building practices to modern ones. Past seismic occurrences, including those in 1934 and 1988 (Dixit et al., 2004), demonstrated the seismic vulnerabilities of both old and modern buildings and brought attention to these weaknesses. A large portion of Nepal's building stock is still vulnerable despite advancements in modern construction because of structural flaws, a disregard for building rules, and a lack of emphasis on earthquake-resistant techniques (Gautam et al., 2016a). In the event of future earthquakes, Nepal can construct more resilient and sustainable buildings by integrating traditional expertise with modern techniques.

Theoretical Lenses: Pillar of Sustainability

Sustainability means meeting the requirements of the present without compromising the ability of future generations to satisfy their wants(Hariram et al., 2023). Likewise, it emphasizes the importance of balancing resource use, social justice, and economic prosperity by focusing on the three pillars of sustainability (Khalili, 2011). Similarly, Goldschmidt et al., (2013)underline that sustainability can be qualitative and quantitative. Sustainability can be static and often requires continuous assessment and modification over time. Furthermore, embracing sustainability helps foster equilibrium through people, profit, and the planet and ensures the well-being of the current and future generations.

Sustainable development is based on promoting human well-being within the ecosystem’s carrying capacity by caring for the earth(“Caring for the Earth: A Strategy for Sustainable Living,” 2013).Sustainable development used to be primarily concerned with environmental issues, but these days it also emphasizes how environmental issues relate to social and economic aspects of development(Wang et al., 2020).The intersection between environmental, economic, and social sustainability is, in fact, a tridimensional term (Bell & Morse, 2012).

Sustainable communities place a strong emphasis on responding to the many requirements of the people living there, which raises their standard, and increases their desire to live and work there. Sustainable communities are well-designed, inclusive, safe, constructed, and managed, providing fair opportunities and high-quality services to all (Eizenberg & Jabareen, 2017). A sustainable neigborhood

highlights the diverse needs, inclusion, opportunities, and the physical environment, enabling social outcomes and fostering a close relationship between the neighborhood and its residents. Dempsey et al. (2011)identify various components of social sustainability. These include education and training, inter and intra-generational social justice, participation and local democracy, health, quality of life and well-being, social inclusion, social capital, community, safety, social order, social cohesion, community cohesion, employment, and social sustainability. Integrating these aspects fosters community connection, support, and empowerment, addressing immediate needs and ensuring future generations with resources and opportunities to maintain and improve their quality of life. This approach creates adaptability, and resiliency, fostering a sense of belonging and mutual support. Society: Recent research has shown that various earthen building assemblies can regulate indoor humidity to achieve optimal levels of occupant health (Liuzzi et al., 2013). The waste pollutes the environment, wastes the resources, and makes operations costly.

Social and environmental sustainability are intimately linked to economic sustainability. Macroeconomically, sustainable practices are those meant to maintain economic growth over the long run while preserving the social and environmental elements of the community. Political sustainability is encompassed in the four-pillar model (Brundiers et al., 2021)and is becoming increasingly important in the modern era due to reports of declining democracies and the need for new forms of governance (Lührmann & Rooney, 2021).However, it is typically disregarded in the traditional three-pillar model of sustainable development. According to the Brundtland Report, "an action is politically sustainable if it allows for the achievement of current political goals and resource needs without jeopardizing future goals and needs" (Broniatowski & Weigel, 2006). Understanding a country's environmental policies and the context in which they operate is essential. Similarly, determining if project control criteria meet legal requirements is critical for political sustainability.

Conceptual Framework

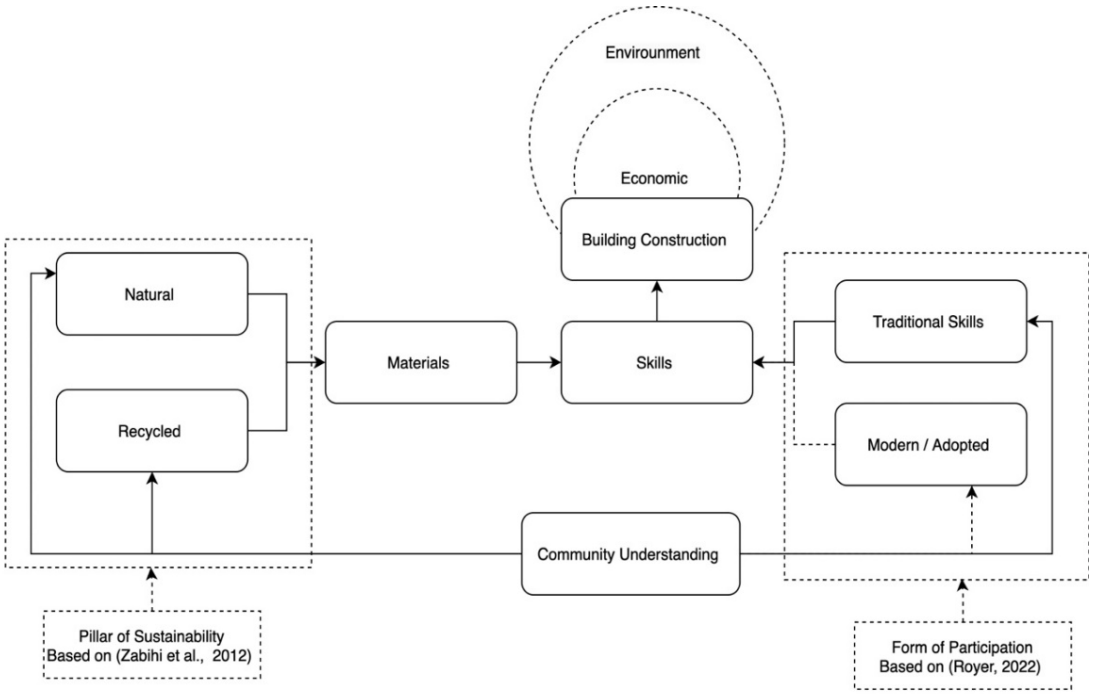
The conceptual framework of the study has been designed to understand the integration of natural and recycled construction materials with traditional and modern skills, aiming at the economic and environmental benefits of sustainable building construction. One of the main aspects discussed in the study is the Pillars of Sustainability. The conceptual understanding of sustainability is based on however, within pillar of sustainability (Zabihi et al., 2012).

This study only looks at two categories of construction materials: recycled and natural. Here, recycled materials are understood to be made by reusing materials from earlier construction projects. Similarly, natural materials in the study are considered to be resources like bamboo, mud, and stone, readily available locally. Based on this understanding, the study examines how building skills are combined with natural and recycled materials. The skills discussed in the study are modern/adopted skills and traditional skills. The study has understood traditional skills as the building construction skills shared by their family members or community elders with the younger generation. In contrast, modern skills discussed in this study are understood as new technologies and construction techniques that demand modern materials and design. The study also examines the forms of participation based on Royer (2022) to understand community involvement in the building construction process.

Thus, the study is designed in such a framework where the findings are expected to give an idea about the aspects of economic and environmental factors in the building construction process and pinpoint the community's understanding of sustainable building practices.

Figure 1

Conceptual Framework of the Study



CHAPTER III
RESEARCH METHODS

The research on integrating traditional and modern construction methods in Dhoksan village is covered in this chapter, with a focus on community perspective and participation. The research was done utilizing a case study technique. Field observation, key informant interviews (KII), and in-depth interviews with a range of stakeholders—including local architects, builders, community leaders, school principals, and residents—are all included in this research. The data, gathered through regular visits to the location, highlighted the use of recycled and natural resources, and the integration of traditional and modern skills. Thematic analysis was used for transcribing, coding, and creating relevant themes and hypotheses. The research upheld ethical standards of informed permission, participant respect, and confidentiality. The chapter describes the research area's features, participant selection, data collection, methodology, and the study's ethical framework.

Philosophical Assumption

The assumptions of research philosophy, ontology, epistemology, and axiology are located within the research paradigm of the study. This section conceptualizes the positioning of these three ontological, epistemological, and axiological stances in the interpretive research paradigm.

Slevitch (2011) argues that reality is arbitrary and cannot be generalized across contexts. The belief is that various subjective realities and interpretations result from the research's constructivist ontologies. Different stakeholders, such as architects, local workers, and villagers, had varying viewpoints and definitions of sustainable building and community participation. The emphasis on participation and the use of local resources helped me realize that reality is socially constructed and impacted by the interactions and points of view of people engaging in the construction process.

The study's epistemological assumptions align with interpretivism. This means that recognizing that knowledge is context-dependent and that understanding the experiences, perspectives, and interpretations of the participants is crucial for gaining meaningful insights. The semi-structured and open-ended questions supported

understanding of the subjective experiences and perceptions of the various stakeholders involved in the construction process. The interaction between knowledge shared by the participants and the researcher throughout the research process is crucial to epistemology (Sol & Heng, 2022). Likewise, the knowledge of reality is gained through social constructions such as language, consciousness, shared meanings, documents, and tools (Klein & Myers, 1999), which were experienced during construction on site in Dhoksan. Hence, it enabled us to deeply comprehend the researcher's epistemological assumption regarding the natural building process.

Research Design

A case study approach is used for this research. The case study aimed to explore integrating traditional and modern construction practices in a community, focusing on participation and understanding people's perceptions. As Creswell (1998) notes, this method allows for a comprehensive investigation of context-specific issues, enabling researchers to adapt their techniques as new areas of interest emerge. The study provides comprehensive descriptions and explanations of the lived experiences of workers, architects, and villagers, allowing for a comprehensive investigation of context-specific issues.

Case Study Design

The research is structured as a single case study with an embedded design. The case here is the Dhoksan community, where a building constructed using recycled and natural materials is considered with the participation. The participatory approach is the core of the case, which is employed throughout the project, and serves as the primary lens through which the study is framed and analyzed. The embedded units of analysis are followed within the case:

1. Specific building projects using natural and recycled materials
2. Key stakeholder groups and their participation
    a. Local people and their perception of natural and recycled materials
    b. Specific building projects: how participation influences materials selection and application
    c. Construction workers and their role in knowledge exchange during the construction
    d. Volunteer architects and their facilitation in the participatory design process.
3. Form of participation observed in sustainable construction practice:

a. Residential and context-based participation,
b. Self-construction and prototyping,
c. Creation of ephemeral artifacts, and
d. Knowledge exchange between local people and international volunteers.

Further, the single case study approach helped create a high-quality theory as it helped the researcher have a deeper understanding of the exploring subject and produce a better theory by questioning the old theoretical relationships and exploring new ones(Gustafsson, 2017).

The case study combines holistic and embedded elements. It provides a broad understanding of the community context and its interaction with natural and recycled materials, which is the holistic aspect. The embedded components focus on specific groups within the community: the residents and the construction workers. This approach enables a comprehensive understanding of the community's engagement with sustainable construction, capturing both the overall Dhoksan dynamic and the unique perspectives of different stakeholders.

Study Area

Dhoksan, a village near Kathmandu situated in the hills connecting Chisapani and Nagarkot, is a hub of Tamang communities. It is located at an altitude of 1810m. It is part of Shankarapur Municipality, Ward 3, approximately 25 kilometers from Chabahil, Kathmandu. Sindhupalchowk surrounds Shankarapur Municipality to the north, Kavre to the east and Bhaktapur district to the south. The area is an elevated land with sloping terrain towards the Khodku and Godavari rivers. The majority of the residents are farmers. The nearby schools teach only up to grade 8, and students frequently have to travel significant distances to school, while the people must walk for at least half an hour to the nearest market. Similarly, Jarsingpauwa is the closest market for Dhoksan residents.

The village is close to Kathmandu, yet the hilly terrain is similar to many other hilly areas in Nepal. Therefore, it could be one of the cases to consider when developing those places as well. The village has been drawing people from the Kathmandu Valley by designing the project with an international organization developing a distinctive design that incorporates both modern and traditional skills, resulting in a beneficial improvement in the village's development process. This study will assist architects and community members in understanding how the technique

might be repeated in different village models where transporting building supplies is problematic. This also helps to understand people's ideas of sustainability, the challenges of introducing new materials, and the success of such introductions.

Researcher's Position

In this study, I'm an observer and conduct on-site interviews with research participants as a researcher. With a background in architecture and a keen interest in learning about the sustainable building methods used in Dhoksan, where the community is involved in the construction process, I focused on this project. Despite being an alien to Dhoksan, I had to interact directly with volunteers architects, and local workers in the area to learn about their perspectives and experiences. As an outsider, initially, it was tough for me to open up with them and vice versa, but after conversing with the folks on site for the interview and sharing lunch and breakfast with them, I was able to better comprehend the work and their experiences. I was conscious of the potential bias throughout the research, and I tried to explain the results while considering the local context and the challenges of combining traditional and modern methods.

Data Collection

While conducting the research, an organized and methodical strategy to data collection was necessary to ensure the reliability and validity of the findings. Given the complexity and contextual nuances of understanding how people perceive materials and how natural and recycled materials are integrated with traditional and modern processes, it was crucial to employ a structured case study protocol. Throughout the fieldwork and data extraction phases, the protocol of the study process assisted by offering a framework that kept researchers on task.

Case Study Protocol:

The case study protocol guided the data collection process, focusing on the integration of natural and recycled materials with traditional and modern techniques in sustainable building methods. The protocol included a set of guiding questions that directed the researcher's focus on key aspects(Yin, 2012) such as traditional skills, modern skills, and natural and recycled materials. Furthermore, for the second question, traditional skills, assistantship, and collaboration, as well as the forms of participation, residency participation, prototyping, self-construction, and ephemeral artifacts, were kept in consideration. The questions were designed to address the research objectives and ensure comprehensive data collection.

Field Observation

Field observation is an integral part of data collection in a case study. The researcher did frequent field observations to get an extensive understanding of the research setting and participants. The first field observation was conducted in March 2023 to gain a better understanding of the study region throughout the proposal development phase. During this time, a brief conversation was made with the workers in the field.

After doing a literature review on 7 April 2024, the researcher visited the site for the second time to visit and interview the key informant, through whom the other possible stakeholders were mapped. Contact numbers of the informants were taken, allowing the researcher to contact them at the time of need. Similarly, the researcher obtained permission from the working volunteer architects to interview the local workers assisting them throughout the site work.

During this time, the researcher also tried to build rapport with the workers by sitting together to have lunch, allowing them to open up more for the next interview. They also enthusiastically invited the researcher to the Momo party they hosted the previous day. They engaged the researcher in the construction site work for some time to try out the new tools they were utilizing, like drilling machines, stitching, and burning wood. This made it easy to travel to the place and interview them because they encouraged each other to do so.

After building rapport, the researcher visited the field continually between April 8 and April 21 to gather data, observe construction patterns, and adapt local talents in building construction. During field excursions, the researcher studied how individuals previously used recycled and natural resources in building construction, as well as how they combined new and old abilities.

It was noticed that a small workshop station nearby the community was used for making prototypes of plastic items, wooden doors, and bottles as part of the support provided by one of the projects in the community. The researcher also observed the surrounding circumstances, material accessibility, and how the community interacted with its built environment. Through these observations, the researcher was able to understand the ground scenario.

Similarly, the second visit to the place to learn about the locals' perspectives was challenging and unique as the locals were initially hesitant to provide information. Therefore, the researcher approached a local lady as a guide to walk

around the village. As a result, people became more friendly and helpful, and the researcher spoke with 75 locals about local and natural materials. Also, women were particularly hesitant to give interviews at first since they believed they knew nothing about the subject. However, after they realized they could respond to the queries, they came forward on their own. After some time, they started noticing the researcher while walking on the road. This bond created an ease for them and they shared more findings. Also, during the last visit of the few weeks on the site to understand the overall view of the Dhoksan community, the researcher communicated with 40 households to understand their perception of the community.

To better comprehend the verbal statement, the old photos of the building site were collected to see whether they matched the verbal statements. These images provided a visual understating of the description. The merging of visual and direct observation data allowed for a more comprehensive knowledge of sustainable construction methods in the areas.

Key Informant Interview

Key Informant Interviews (KII) were conducted with people who possess knowledge of the building and construction that had taken place on the site, and their experiences related to the study were focused on after receiving their contact numbers from the other key informants. The participants were selected based on their roles and expertise in local construction, role in community leadership, and environmental sustainability. Interviews with ordinary people may not yield as much valuable knowledge as KII claims to produce since it requires “special or expert knowledge” regarding a particular subject(Lokot, 2021). It is essential to interact with key informants to obtain “insider” knowledge, especially about delicate subjects (McKenna et al., 2011).

The KII was conducted once with all the chosen Key Informants and few were later approached again as needed to ask a few more questions. The questions used in this process were broken down into three sections. The first section focused on the questions that were specifically asked in a semi-structured manner about residential participation, ephemeral artifacts, self-construction, and collective participation. These inquiries were designed to gain insight into the participants' and workers' actual experiences during the building process. The questions were mainly focused on the form of participation and around 35 – 40 semi-structured questions were asked, taking around two and a half hour to three hours for the two to three-sitting interview.

Selections of Participants

Initially, a local architect who had previously worked on the site recommended persons to see and possibly interview candidates. Similarly, the community participant nominated a few candidates for the interview. After that, I contacted them, and only a handful was available. So, I went to the location where they are currently working on their next project,.I met the prior workers and interviewed them. In the meantime, they recommended other workers who had been on-site, and I began interviewing them. Hence, purposeful sampling and snowball sampling were used to interview the participants.

Table 1

Details of participants of the KII and in-depth interview

Representatives	**No of participants**		**Rationale**
	Male	Female	
Key Informants			
Local Construction Workers	6	1	These individuals actively construct buildings in the community.
Architects	3	1	The architects are the ones who initiated the prototyping on the site.
Community Representatives	3	0	These decision-makers have the potential to provide an overview of the community's role in the construction approach.
In- depth Interview			
Local Construction Workers	6	0	As local workers have experience of working in traditional and modern skills.
Community Representatives	2	0	Community members to have a common understanding.
Architect	0	1	Technical understanding of building construction

Brief Introduction of the Research Participants

The research participants were chosen based on the requirements of the research questions that were prepared. To better understand the local participants living in Dhoksan, Ward number 5, interviews were conducted to see whether they knew the potential and use of recycled and natural materials in their community. If the structure built by the organization has truly helped them recognize the new potential for construction in the village's development. Similarly, for the second study question, the local workers and volunteer architects, who had worked on the site of the building created out of recycled and natural materials, were employed, as well as the community participants who have been closely involved in the decision process.

In-depth interviews

Interviewing is the greatest technique for discovering real versions of participants' experiences since it provides in-depth information on participants' experiences and perspectives on a specific topic (Turner, 2010). It aligns with Erlandson's (1993) statement, "Interviews also help the researchers to understand and put into a larger context the interpersonal, social." So, in-depth interviews were conducted to explore the stories for data collection. The in-depth interview in the study helped to understand the participation of community members in the building construction process in detail as they shared their perceptions about natural and recycled materials, which were shared by many stakeholders, such as workers and architects at the time. Also, while conducting key informant interviews, few interviewees with good knowledge about the subject could answer these questions. They were again selected for the in-depth interview. Only the interview allowed for the integration of elements such as material composition, prototype process, and feelings of inclusion or exclusion. Similarly, interviews provide an opportunity to learn more about their experiences and the environment in which they live. Therefore, in-depth interviews helped in the process of understanding the knowledge and perception in depth for the research work.

Similarly, open-ended questions were asked to make the interviewer feel more at ease and start the topic, and after that, semi-structured ones where few topics and subtopics were mentioned and questions based on it were asked to make it more to the point at some point in time. These questions were designed to help participants

understand the traditional knowledge used in the community, both past and present. Additionally, a conversation (walk and talk) with community members in Dhoksan was done.

Meaning Making and Interpretation

This section outlines the process of interpreting data collected through qualitative methods. Coding, which involves organizing data into understandable units, comes after transcription, which involves meticulously transcribing and translating interviews into English. After that, the data was categorized into themes to aid in formulating study questions. Lastly, theorizing connects these results and preexisting ideas, offering fresh viewpoints on sustainable building through the combination of natural and recycled materials.

Data Transcription

Transcribing talks with participants or from other audio sources into written form was done by researchers using transcription (Cope, 2017). Researchers interviewed participants following each site visit and then wrote and recorded the results. Given my previous experience in qualitative research, it would be difficult to transcribe data while listening to it. As a result, I tried to take notes simultaneously while recording the interview, which made it much easier to transcribe and listen to the recording to see whether I had missed anything. As Dornyei stated, a one-hour interview can take up to six to seven hours to transcribe, with approximately fifty pages of transcript: researcher spent weeks transcribing the dialog between the participants and researcher. The interview was done in Nepali, with intermittent code-switching between Nepali and English. While transcribing the interview, researcher converted it into English.

Coding

Following the transcription, the researcher proceeded to the next step: code and develop themes. The researcher reviewed her notes and listened to the interview again to see whether she had missed anything. The researcher also read the notes several times, emphasizing the participants' perspectives and experiences. The words, sentences, and phrases were repeated numerous times before being collected and structured as a single code. Coding creates an analytical chain that answers the research question by connecting, conforming, and integrating the major themes found in the data analysis (Charmaz, 2006). In other words, it is simply the process of dividing, grouping, reorganizing, and linking data in order to extract meaning from it

(Grbich, 2022). For example, the interviewee constantly stressed the knowledge exchange between the two groups, emphasizing the importance of local knowledge above current knowledge. As a result, these were coded as an exchange of knowledge, emphasizing the necessity of preservation, which aids in classifying these codes and later classified in a group of assistantships.

Classification and Thematizing

Thematic analysis is an analytic approach that identifies themes or patterns in textual material and then interprets the results in a thematic structure based on commonalities (Bryman, 2012). The coded data was then divided into many themes, including traditional knowledge, assistantship, cooperation, community engagement, residential participation, self-construction and prototyping participation, and ephemeral artifacts. The data was then grouped and classified to create themes that define words and phrases in greater depth. Themes were identified based on their repetition, participant focus, and relevance to the study topics.

As a result, based on the objectives and relevance to the research questions, the themes were mainly organized around four topics initially established in the contextual framework of the study: natural materials, recycled materials, and traditional and modern skills. In addition, during the conversation with local people in Dhoksan, their questions were also thematic under these topics. Finally, themes are crucial in coding qualitative analysis methodologies, leading researchers to develop theory (Saldaña, 2016). These certainly give rise to theories. The researcher used (Clarke et al., 2019) approach to describe the theoretical underpinnings of the themes discovered through data analysis. This approach facilitated systematically connecting emerging themes to established theoretical notions, resulting in structured and well-grounded interpretations of the data.

Theorizing

Theorizing is the process of discovering a new perspective on an issue and developing a clear narrative that links results to current theories. This study focuses on combining natural and recyclable materials with traditional and modern techniques to improve sustainable building methods. Sustainability literature emphasizes the environmental and economic benefits of using natural and recycled materials. Community involvement and participatory approaches are required for environmentally responsible, culturally appropriate, and socially acceptable construction processes. The blending of traditional and modern skills is investigated

to better understand its impact on the community and how it might be implemented further. In order to provide a comprehensive model for sustainable construction, the research develops a theoretical framework that accounts for the dynamic interactions between materials, skills, and community involvement. The process of theorizing is iterative, generating new insights and expanding our understanding of sustainable construction methods by tying together empirical data with preexisting theories.

Furthermore, the most challenging aspects of developing a theory are remaining objective and avoiding prejudices and preconceived notions (Yin, 2004). Because case study research involves the study of a social unit in its natural surroundings, the researcher has kept her biases at bay and not superimposes them on the subjects or while interpreting the data. As a result, researchers kept this in mind and relied on theories to support and justify their views, statements, and narratives.

Using the explanation building strategy (Yin, 2012) adds to the theoretical discussion, examines the present theory, and provides new viewpoints on how to integrate recycled and natural materials with conventional and modern building methods. This method makes it possible to create a thorough model for sustainable construction, which adds significantly to the collection of knowledge in academia and the practical use in the field.

Ethical Considerations

Ethical consideration was considered during the research practice where specific guidelines were used to support the validity and integrity of the study. The researcher was legally obligated to get the recorded audio-informed consent before participating or observing, and all participants were pre-approved. Hence, with respect to the Kathmandu University, consent forms were signed before visiting the site for the study. The researcher was clear about the extent to which participants' comments and actions would be recorded, and the participants were informed about the potential and long-term effects of participation in the research.

Confidentiality was ensured by building a rapport of trust with the participants, ensuring that their sensitive and private information would not unintentionally or knowingly leak data or provide information beyond what had been promised. The report used fictitious names and pseudonyms to allude to individuals or groups to protect their identities. However, there is no exact point at which it is appropriate to stop watching and documenting a participant's conduct once they have their approval and have informed them of their participation.

Potential harm was addressed by conducting interviews at a time that worked for the participants, avoiding repeated questions, asking meaningful questions, and taking careful notes. The interviewer did not elicit answers that could be insensitive to a participant's culture, values, or sense of dignity (Tracy, 2010). Throughout the research, the researcher carefully assessed delicate situations that might result in psychological or emotional injury.

The recorded video, audio, and pictures took appropriate measures to store and handle data securely, ensuring that individual identities were protected. Additionally, the construction timetable was followed to make the most of the time and take major safety precautions. Overall, this study aimed to maintain high standards of research quality and ethical conduct.

Chapter Summary

The chapter describes the study region, participant selection using purposive and snowball sampling, and methods for information gathering and interpretation such as data transcription, coding, and thematic analysis. The study focuses on credibility, ethical consideration, informed consent, confidentiality, and respect for participants' rights ensuring a thorough and ethical investigation into participatory techniques of natural and recycled building process.

CHAPTER IV
PERCEPTION OF COMMUNITY MEMBERS TOWARDS MATERIALS USED AND TYPES OF BUILDINGS

This chapter explores the community's natural and recycled building construction materials and explains how they are framed and discussed in the context of the five pillars of sustainability. The data for this chapter is collected through in-depth interviews. In addition, the researcher also framed a structured questionnaire and asked community members in conversation (walk and talk) with around 75 local community members to understand their perception of sustainability regarding the use of natural and recycled materials and choices among modern and traditional skills for building construction. All names used in the chapter and afterward are pseudo.

Perception of Community Members Towards Natural Building Materials

Natural materials are readily available resources in the area and are frequently used in building construction. In the past, mud, stones, wood, slates, straw, and adobe—all naturally occurring materials readily available in Nepal—were used to construct houses. These materials serve as complementary, insulating, and structural elements. During the in-depth interview, Ram, one of the members, said that houses in Dhoksan were made from these materials. In addition to that, he also noted that bamboo, particularly *"Paro Bas1"*is readily accessible locally and costs about NPR 200. He also shared that the old buildings of the community were constructed using adobe or bricks in addition to stone.

The study reflects that the locals of Dhoksan are learning how to use local materials in a more advanced way in the current environment, as they also collaborate with some of the international projects that make buildings using recycled and natural materials. When asked about the materials that would be best for building homes in Dhoksan, Ram shared that olden structures were built out of wood, and these woods were carved with intricate details as ornamentation for design purposes, which were also part of their cultural and social identity. Likewise, another community member, Hari, shared the details of how the construction of the traditional houses is done:

[1] Paro Bas refers to the name of local bamboo available in Dhoksan and the locality.

> Traditional homes from the past were constructed with wood, with beams laid first, followed by *"Nigaula[2]"* or tiny cross beams, and then bamboo layered on top. After that, plastic is arranged, and finally, mud. Usually, plastic is positioned on top to prevent mud from falling onto the lower floor. *Kamo[3]* is larger, with dimensions of 10 inches by 10 inches. Wood is used to make *Dalin[4]* (beam), and bamboo is made by breaking into halves and placing them on top of the beams (Dalin). To prevent the mud from falling, the bamboo is then spread out and covered with plastic. (H. Tamang, personal interview, April 20, 2024).

These details are still prevalent in some of the houses that the researcher visited for the interview. In those houses, bamboo is used as a secondary structure, along with struts and poles, and wood and mud, for the construction of the wattle and daub. Stone and mud are locally available materials, and the residents possess good knowledge of using mud as mortar. The composition of mud with cow dung and straw is used to increase the strength of the mud, which is then applied for plastering both interior and exterior walls. However, due to the unavailability of new materials, most of the roofs in the area have been replaced with corrugated galvanized iron (CGI) sheets because of the unavailability of slates. During the field observation, it was seen that the majority of houses in Dhoksan have galvanized sheets, and the countable houses have reinforced cement concrete as a roof.

During an in-depth interview, Hari reflected on his childhood in a three-story mud house.

> The roofs were initially composed of "Chwali," which was later covered with stone slates. Stone was chosen because it is more durable and requires less maintenance than "Chwali." Every two years, Chwali must be updated. The use of Chwali in Dhoksan's houses is currently negligible. (H.Tamang, personal interview, April, 20 2024).

Similar to Hari, Sita also pointed out that one of the school's roof extension buildings was built using *Chawli*[5] and that, given the current circumstances, it is

---

[2] Nigaula: joist laid on top of the main wooden beams to provide additional support and structure before layering bamboo and other materials.
[3] Khamo: wooden components with dimensions typically around 10 inch by 10 inches, used in the construction framework to provide substantial support, often placed underneath the "Dalin" beams.
[4] Dalin: This is a beam made out of wood, which serves as a primary structural element in the construction of traditional homes.
[5] Chwali: the type of grass used for the roofing.

difficult to locate these resources, which were formerly easy to find. Reinforced Cement Concrete (RCC) houses have already been built, indicating the village's progression toward urbanization. Dhoksan's RCC construction houses are made up of mud-bonded bricks/stone and cement-bonded bricks. During the conversation with the community, it was noticed that few natural materials are available, which has also forced the community to use varied materials available in the market.

Amar, one of the community members involved in the construction of the new kindergarten school in Dhoksan with the international volunteer, emphasized the importance of traditional knowledge in the construction process. He mentioned that even though RCC construction has become more common, they still perform rituals like “pooja” during the foundation phase and maintain the cultural symbols like “lundar” outside their homes. He believes that preserving traditional houses could attract tourism and support cultural heritage. He stated, “We are having discussions about building homestays that represent vernacular architecture as tourists say that they have been living in concrete tall buildings and come to these places for refreshment and to experience new things” (A.Tamang, personal interview, April 22,2024).

Kiran, another local, added,

> “There is traditional pooja for the foundation, where they offer Tama coins, bheti, and singudi (cactus), which are natural resources. Others go to lama and gumba for other poojas. We also suggested extruding the roof for the mud houses, but they didn’t listen, and now it is affecting the structures” (K. Tamang, personal interview, April 22,2024).

During the in-depth interviews, Sonam, one of the international volunteer architecture students, observed that traditional construction methods, such as using wood for beams and structures, are sustainable practices. She noted that in Dhoksan, the traditional knowledge of combining natural resources like cow dung and mud to enhance the strength of building materials is still prevalent. Sonam highlighted,

> “Staying in Nepal, we were able to think in terms of context. Temples, for instance, are built out of wood and are structurally sound and easy to use too. The use of wood is emphasized because it consumes less CO2, and the traditional methods align with sustainable practices” (S. Muller, personal interview, April 20, 2024).

Through the in-depth interview, the study found that traditional houses were climate-responsive, keeping cooler in the summer and warmer in the winter. Furthermore, the community people shared that the houses made of natural materials are durable and have a longer lifespan. Most of those who participated in the walk-and-talk conversation also stated that because government rules and regulations favor concrete buildings, everyone has begun to build them. Most community members also shared that they would like to live in houses made of natural materials. They believed that locally available natural materials offer high thermal efficiency and strength performance, and are cost-effective and environmentally friendly (Khoshnava et al., 2020). Many pioneering initiatives have demonstrated that green buildings may provide their end users with a healthier living and working environment while significantly lowering maintenance costs due to enhanced efficiency (William Dobson et al., 2013).

Since the 2015 earthquake in Nepal, the majority of buildings reconstructed afterward have been built using concrete materials. During the field visit, only three traditional houses were found in Dhoksan.

Similarly, Amar and Chetan, two local workers on research site, agreed on less traditional houses present in Dhoksan and added their perspectives:

> In the village, there are 3 to 4 houses constructed traditionally. After the earthquakes, these houses were destroyed, and cement construction was built in their place. Usually, the old houses were built out of stone with straw and mud on the roof. These houses were also built out of raw bricks or adobe. However, I do not feel that constructing these houses with the natural material helps the environment, or does it in any way? (A. Tamang & C. Tamang, personal interview, April 20, 2024).

“Even one of my houses, post-earthquake, has some cracks. We are using it to shelter our domestic animals, and it is designed in a traditional style using natural materials” (H. Tamang, personal interview, April 20, 2024).

The study found a shift in perception in community members during the 2015 Nepal Earthquake and post-earthquakes; the community started feeling safer in buildings built with modern materials rather than natural ones. Ram stated during the interview that traditional buildings have adequate space to run during an earthquake whereas the construction of modern houses leaves less open space as they are constructed in narrow spaces. The research participant stated that they are switching

to other construction materials over natural materials because of a lack of effective structural systems, particularly in the aftermath of the earthquake, as well as government regulations and laws.

Likewise, Sonam reflected on the cultural significance and environmental impact:

> We came to know that wood is available in Nepal, especially Sal, which is easily found in the South. Hence, pine was used for the newly constructed school that we are designing for the facade and Sal was used for the other parts as structures. Concrete buildings are not good for the environment, so traditional ways of building are mostly emphasized. Staying in Nepal, we thought in the context where temples, for instance, are built out of wood and are structurally sound and easy to use too.

However, the mainstream construction industry is hindered by several factors from using natural building materials, including a lack of environmental measures to guide decisions at every stage of the design process (Woolley, 2007), insufficient data to quantify and accurately measure their energy performance in various climates, and a lack of environmental measures to inform decisions at every stage of the design process (Ben-Alon et al., 2021). Similarly, there is inadequate experience in using these materials in the mainstream construction sector. This gives the impression that these materials are low-tech and have poor performance. Despite these challenges, natural building materials can reduce transportation costs and improve the energy efficiency of sustainable construction (lower economic) demand for realization and operation of constructions (Spišáková & Mačková, 2015). Moreover, natural materials in the construction industry help promote sustainability goals, such as those outlined in the Paris Agreement, by promoting the circular economy principle and reducing reliance on non-renewable resources (Ghisellini et al., 2018; Herczeg et al., 2018).

Perception of Community Members Towards Recycled Materials

Understanding recycled materials among the communities is multi-faceted, reflecting various environmental, social, economic, and cultural dimensions. The conversation with the community showed that people had a mixed attitude toward using recycled materials in housing construction. However, most people in Dhoksan showed a positive attitude towards recycled materials. However, some of them found recycled materials worthless. The primary advantage recognized is the environmental friendliness of recycled materials. Despite this, concerns about the cost, durability, and safety are prominent. There are also worries about availability and aesthetics.

These concerns indicate an openness to using recycled materials, tempered by practical considerations regarding quality and economic implications.

During the study, most of the participants mentioned safety as an advantage of recycled materials; however, some of them also shared that sites are dangerous without proper health and safety measures in place, sharing their experiences of the work they had earlier seen while constructing buildings using plastic and bottle which were dangerous to some extent.

Ram and Hari, the local construction workers highlighted the complexities on working with the recycled plastics. Ram shared that while plastic can be reused, the process of cleaning and preparing the material is difficult.

> We opened the plastic and cleaned it in a big pot (dekchi), but the smoke caused breathing problems. Despite being provided with mask, there was a health risk due to the fumes. Making just four tiles took around 30 minutes. (R. Tamang, personal interview, April 20, 2024)

Sita, the female worker on the site added that people who worked on the department of the plastic were usually sick after working on it even with the usage of the safety like mask.

They are also well aware of the benefits that using recycled materials in building construction may bring. When asked about the building with recycled materials, the community member shared that wood, stones, and bricks are primarily recovered after disasters or house demolitions. Post-disaster waste management is essential to lower the necessity for natural resources in the city's reconstruction efforts following a disaster. Niraj,a volunteer architect, highlighted that recycling waste materials like wood and stone can be efficient, but the lack of local expertise in Dhoksan poses challenges. He suggested that more hands-on training and skill sharing are required to help community members adopt these practices effectively. This addition will emphasize the gap between the traditional knowledge and modern waste management techniques.

Debris, which includes demolished parts of the building, such as stone, wood, and mud (Memon, 2015), can be efficiently managed. The 2015 earthquake in Nepal generated significant debris, with 57.96 percent coming from housing reconstruction. Usually, wood was typically recycled into the form of wooden bands, door/ window panels, furniture, and formwork. However, in the Kathmandu Valley and outside of

earthquake-affected districts, a large amount of demolished brick and concrete debris has remained as discarded waste (Gyawali, 2022).

Dahal et al. (2023) discuss that bricks were found to be the highest-ranking waste, scoring 50 percent, followed by reinforcement bars (20 percent), concrete and masonry (20 percent), and wood (10 percent) on the research site. Using recycled bricks can help reduce landfill issues and is economically beneficial and eco-friendlier (Wong et al., 2018) helping lower carbon emissions, improve soil quality, and advance in building a circular economy (Deb et al., 2024). Additionally, several studies indicate that recycled brick aggregate might be used instead of the natural coarse and fine aggregate in concrete and mortar (Wong et al., 2018). By reducing the adverse impact on the environment, preserving resources, cutting construction expenses, and fostering a circular economy, recycling bricks contributes to longer-term solutions that will aid make a more sustainable and greener future.

Furthermore, Wilkinson et al. (2012) have discussed the potential of using the waste of buildings demolished by disasters to reconstruct similar kinds of construction guided by their local knowledge and with the support of other natural materials available. Likewise, Dabaieh et al. (2022) show that using vernacular construction techniques and local building materials helps achieve circular economy principles. In the study by Castilla et al. (2020), it is mentioned that it is occurring in the most remote areas of the mountains, where access is limited and it is possible to distinguish between the architectural styles associated with various ethnic groups in different regions; the communities use the local materials, primarily stone, and wood. These strategies address the logistical and environmental challenges and promote sustainable development. Nepal's construction sector is paving way for a more resilient and eco-friendly future. Traditional knowledge and skills regarding the building practices in Dhoksan are not well-documented, and community members are not well-practiced in this area as they are more interested in constructing buildings using modern skills, technology, and materials.

One of the community members, Ishak, shared,

"I have been collecting the bottles to build a toilet out of it rather than building a whole residential building out of it" (I. Tamang, personal interview, April 20, 2024).

The environmental advantages of using recycled materials were also acknowledged by a previous site worker who worked with a foreign volunteer. However, the worker also emphasized that local materials, like stone and mud, align

with the community's traditional building techniques. He said the local population frequently feels its opinions are ignored, even as international architects bring in new and creative ideas, such as the utilization of repurposed materials. According to Soham Bahadur, improved cooperation between foreign experts and local builders could lead to more workable and culturally appropriate solutions for using recycled materials in buildings.

The study also found that the community members were not very comfortable with the materials, as during the conversation, they did not show interest in constructing their houses with recycled materials. Thus, the study also reflects that it might be due to a lack of knowledge and policies on building with recycled materials at the local and national levels. Prakash, a community representative reflecting on the government priorities:

> We need stronger policies on using recycled and natural materials. Concrete is common but unsustainable. With better management, especially in terms of agricultural land and concrete waste, we could integrate more eco-friendly materials into building projects. The drawings of the building have not been passed and it will take time. There is a group of communities which is known as the “Chemeki” board. For the process of passing the drawing in the municipality, it needs to be estimated and paper needs to be designed and it also needs to be documented and organized. (P. Tamang, personal interview, April 20, 2024)

Furthermore, inquiring further about their opinions on the possibility of using waste stones or bricks for building construction, the construction worker interviewed for the study shared that they can utilize stones in their construction as they can be used for soiling. Ishak further shared about the use of organic waste to construct the building, as the waste straw was mixed with the mud using rubbles from the demolished houses. However, if we use wasted brick, it can help us in the construction. Many nations adopt varied policies about building and demolition waste and raise public awareness to mitigate environmental effects (Pešić et al., 2016).In addition, building new homes remains costly for low-income households due to expensive transport for far-away fired bricks, high totals of cement for fired brick masonry, and ever-increasing material prices.

Traditional and Modern Approaches of Building Construction

Traditional skills are found to be valuable in the construction of buildings. Audefroy (2011) highlights that traditional construction skills have demonstrated highly acceptable behaviors during earthquakes in the vernacular structures. Here, vernacular structures are the ones that have changed over some time, reflecting the environmental, cultural, technological, and historical context of a specific location in which it was built (Nguyen & Reiter, 2017). Likewise, Martín et al. (2010) found better indoor conditions in traditional houses due to high thermal insulation, while Huang et al. (2017) found higher average relative humidity in vernacular houses (83 percent vs 75 percent in modern buildings) due to higher thermal insulations. Therefore, this traditional knowledge and people's skills helped the vernacular architecture manage the relationship with the local climate. The study shows that community members of Dhoksan are choosing modern skills over traditional skills due to the regulatory and building code restrictions and the increasing narrative that traditional methods are outdated. However, during the conversation, one of the builders mentioned that in the past, there were ways to make the traditional building structurally sound by placing a band around the house during construction in a similar manner that in Nepal, temples are created out of wood that are structurally sound and convenient to use. One of the International architecture students interviewed for the study, Sonam, shared her understanding, “Traditional buildings are seismic proof and can be referenced by old temples built in Nepal. However, there are few documents on joinery details for wooden bands used in traditional buildings” (S. Muller, personal interview, April 20, 2024).

The traditional houses are rectangular, three-story structures (Forbes, 2018) made from locally sourced materials like stone, mud, bamboo, and wood (Bista, 1967), unburnt brick walls, clay plasters, wood frames, and slate roofs. In addition, the walls consist of timber plants and lathes covering both sides with a mixture of mud and cow dung (Bodach et al., 2016). The house features small windows and thick walls to regulate heat, and their high thermal mass makes them better thermal performers than lighter modern buildings (Bajracharya, 2014). The houses vary in construction, depending on the local resources, geography, and climate (Forbes, 2018). Usually, the supporting structures or pillars are made of wood. Roofs made of straw or slate tiles offer excellent weather insulation, keeping homes at reasonable temperatures. Steep-pitched roofs with 60 cm overhangs against rain and summer sun

while allowing winter solar heat (Shrestha & Shrestha, 2009). Wide eaves protect the walls from rain, while fibrous mud plaster is applied regularly for waterproofing.

One of the important reasons behind the decline in interest of the community towards traditional skills of building construction is the lack of skill transformation from the previous generation; as one of the participants of the interview, Gita shared, "We are getting trained to construct the houses using modern materials in modern ways and lack the proper skills to construct traditional houses" (G. Tamang, personal interview, April 20, 2024)

However, during the conversation, community members practicing housing construction shared their interest in the traditional house construction training programs. They also shared the concern that these traditional houses should be earthquake-resistant buildings to attract larger community members. The hidden rising interest of community members towards traditional building construction is the possible economic benefits of tourism as one of the participants mentioned

> "Dhoksan lies on the way to Nagarkot. This tourist site also serves as a hiking route. If we could construct the houses using traditional resources, it may also attract more tourists, as they prefer to visit traditional structures rather than cemented houses" (A. Tamang, personal interview, April 20, 2024).

Furthermore, the increasing socio-cultural and economic activities also demand traditional buildings in the community. The participant Gita shared, "Homestay is already operating in 16 houses in Dhoksan and will continue. Guests frequently express that they wanted to stay in traditional houses and do not prefertostay in the cement houses" (G. Tamang, personal interview, April 20, 2024).

The reviews from the tourists also encourage community members in Dhoksan to think about the necessity of preserving traditional houses, and a majority of community members also share the importance of traditional building styles.

One of the participants of the study, Amar, shared the examples of Ghandruk village, located in Kaski district, which looks beautiful due to the preservation of their culture and further shared that Dhoksan also has similar potential to create a unique identity, believes that preserving these styles can help in creating a unique identity of the Dhoksan regions.

Furthermore, the influence of the foreigners in the village has also helped the community members and schools to rethink their system and introduce new methods

of incorporating education to empower children from a young age. As one of the participants, Ram shared,

"The younger generation should learn about the vernacular architecture, promoting designs made of mud and stone. The modern techniques, like wooden lintel structures, can be integrated into traditional methods" (R. Tamang, personal interview, April 20, 2024).

With the change in the building construction landscape in Dhoksan, the local people are realizing the importance of traditional buildings over modern ones. The majority of them shared their feelings more connected in the traditional houses over the modern houses too.

In Dhoksan, while building traditional houses, individuals help one another with everything from locating local materials to preparing adobe and putting bricks and stones, fostering a sense of community. Traditional houses provide a space to connect with the people.

Traditional building skills are important as they preserve craftsmanship and masonry in modern construction times. Dhoksan people have a good understanding of their importance, as most consider it very important. Through the conversation, it was also understood that the community believes traditional skills houses have higher resale values as traditional skills are getting lost and their value has increased. Despite the potential benefits, challenges are associated with using traditional skills in modern housing projects. In the interview, a participant mentioned a lack of skilled labor in applying the traditional skills effectively.

The construction of traditional houses in Nepal requires a substantial workforce. It is very challenging; for instance, there is a risk of stone breakage due to the lack of strong pillars. In the past, local people referred to *"Aicho paicho*[6]*"* as (mutual help), however, Baulch et al. (2008) referred arma parmas as agricultural labor exchange associations found among the Gurungs of Western Nepal and Limbus of Eastern Nepal. While *arma parma*[7] focuses on labor exchange, Subedi & Maharjan (2021) describe aicho paihco as an exchange of goods, not mutual aid. This distinction emphasizes that while people helped one another during construction, the phrase, aicho paicho refers to product exchange rather than labor support. However,

[6] Aicho Paicho: exchange of good
[7] Arma parma : labour exchange

modern times have seen a decline in skilled workers and increased construction costs, making it unaffordable for many.

On a cultural note, the majority of people in Tamang communities are Buddhists and place *Lundar*[8] outside their homes. They also consider aspects such as door orientation and building design following the guidelines of Vastu Sastra. *Vastu Shastra*[9] is ancient Indian Vedic and Shastra wisdom used in architecture to attain balance and harmony between gods, nature, and people, opening the road for peace, prosperity, health, happiness, and avoiding trouble. Also, *pooja*[10] is performed before the foundation is built, and when the construction is finished, *hom*[11] is performed, and thread is tied, which makes them feel connected and gives them a sense of ownership of their traditional houses.

Regarding sustainability, Sabatini (2019) mentions that culture should be viewed as a fourth and central support as it aids in diversifying mono-cultural economies and enables a more competitive development platform. In addition, Zabihi et al. (2012)mention that buildings have a less negative impact on the built and natural environment. Thus, conserving limited resources, reducing energy use, and managing the building stock appropriately will enhance environmental quality. It further emphasizes the five pillars of sustainable development: ecology, society, culture, economy, and policy.

Haphazard Urbanization

Another issue noticed during the field observation was that due to the haphazard construction of houses, there is limited land left for agriculture. Most households in Dhoksan is engaged in agriculture as it is primarily their source of income. The study found that the wetlands do not contain any water despite having a lot previously (as informed by the villagers). But, in today's scenario, the situation has changed; participant Hari, in the interview, shared,

> These days, there are two sources of water down the hills that we gather and use by lifting down the road, and then in the morning, for 20 to 30 minutes, we

[8] Lundar: usually hang on tree on the monastery and also changed every year.
[9] Vaastu Shastra: ancient Indian Vedic and shastra wisdom used in architecture to attain balance and harmony between gods, nature, people, opening the road for peace, prosperity, health, happiness and avoiding trouble
[10] Pooja: Hindu ritual of worship involving offering, prayers, and ceremonies to honor deities or celebrate spiritual events
[11] Hom: Vedic fire ritual performed to invoke divine blessing, purify the environment, and achieve spiritual goals.

> open that water and give it to 27-28 houses. So, we have to pay 200 rupees every month, and for 27 families, we pay 3500 to the person in charge of transmitting water, closing and opening the tap. (H. Tamang, personal interview, April 20, 2024).

This scenario has also impacted the construction process in Dhoksan, as water must be lifted and used, adding to the difficulty and cost. The reliance on a restricted water supply frequently results in rising expenses. As defined by the pillar of sustainability adopted by the study, Ecology studies the environment's impact on people and nature, including land use change, water supply, waste disposal, employee training, and industrial and urban sewage treatment. Land use change can directly affect sustainable development, biodiversity, and climate (Kong et al., 2022). Examples include converting agricultural land to residential areas or converting natural habitats for agricultural production (Ackerschott et al., 2023). Likewise, the reduction of agricultural land increases water infiltration. This kind of awareness must be provided to the people living in the community to foster environmental awareness (Piwowar-Sulej, 2021).

The study also discloses how the influence of urban areas near Kathmandu has disrupted the existing system, which was more convenient and fostered social cohesion in Dhoksan. During the field visit, the researcher observed community people engaged in "[12]Shram Dan" (voluntary labor) to build a community building. It was surprising to see that the thing that has already vanished from the city area is thriving in a place only 25 km away from Kathmandu. This shows that amidst mushrooming urbanization, conventional practices still thrive in some places, and it is crucial to realize that such unique local needs and practices should be preserved.

Chapter Summary

This chapter thoroughly discusses the use of natural building materials, highlighting their critical role in construction practices based on the collected information for the field. The chapter explains how materials, such as mud, stones, timbers, adobe, and straw mixtures with cow dung, reflect the traditional methods practiced in Dhoksan. Furthermore, participants' voices have explained how locally available materials improve structures' energy efficiency and aesthetic appeal, preserving traditional architectural processes and techniques that have evolved. The

[12] Shram Dan: voluntary labor

study pinpoints that though natural and recycled materials have numerous advantages, they also show inadequacies in the mainstream building industry's understanding and use of these resources.

The chapter has also reflected limitations, such as a lack of scientific data to assess performance, limited expertise in natural materials, and misconceptions about their efficacy that prevent widespread use in construction projects. Furthermore, the chapter emphasizes combining traditional construction abilities with new information to provide adaptation planning. Bridging the gap between traditional and modern architecture and methods is necessary to solve developing difficulties in the built environment.

CHAPTER V
BUILDING CONSTRUCTION SKILLS

The study explores using recycled and natural materials in Dhoksan building construction, focusing on the benefits of traditional and modern building construction skills. This chapter shows how the findings of the study highlight the need for interconnection between traditional construction skills and modern skills, the interconnectedness of sustainability and cultural preservation, and the transformative influence of collaborative learning. The chapter also discusses how modern skill enhancement programs can preserve traditional building construction skills and adapt them to modern needs, ensuring development as well as cultural continuity.

Traditional Skills

Traditional skills refer to local people's notions and cultural understanding of everyday life(Ingold & Kurttila, 2000). This knowledge benefits communities and the environment (Mety et al., 2022). Thornton and Herrero (2015) share that there is much to learn from traditional and community-based approaches to solve the evolving problems of the communities. Thus, incorporating traditional skills systems into other evidence-based knowledge may be one of the most effective and sustainable approaches to solving communities' emerging environmental and economic issues.

The buildings of Dhoksan were once constructed of stones and mud. A locally accessible mud used to build the houses is called *"peri mato."* The community that participated in those kinds of building constructions is aware of the composition of the soil and how it should be used for building. During the field visit, the researcher saw one of the recently built rammed earth and mud buildings in the study area. During the in-depth interview, a worker who had previously worked on that construction project revealed that while choosing materials for mud building, they had thought about using metal, cement, and stone, among other things, until mud appeared and became the greatest option. When questioned for additional information, he responded,

"Architects inquired about locally available muds suitable for the construction process, which were Chimti Mato, which the locals mentioned, and hence decided to

use those materials for the construction due to their availability" (M. Tamang, personal interview, April 20, 2024).

He added that during the discussion, workers also shared information about the availability of materials and where they can be found. This reflects how the process of building a mud house initiated an exchange of knowledge; in addition to mud, workers also shared knowledge about bamboo and how to tie and hold the bamboo for greater strength with the foreign architect (who initiated the project) also involved in the process.

Furthermore, the workers also shared the composition of the mud for better strength and workability. One of the workers, around 50 years old, mentioned, “We mixed 113 gada straw, 1 gada mud, and 1 gada sand. In addition, we had also suggested adding cow dung to increase the strength of the composition” (P. Tamang, personal interview, April 20, 2024).

Similarly, using waste was established when farmers often generated many straw wastes used in construction. In rural regions, organic agriculture waste like cow dung has been used to reinforce mud and avoid fractures (Lekshmi et al., 2020), which is also used on-site where they also made various prototypes to check the length of the straw and the strength it provides. Though traditional, this knowledge still applies to today’s age.

The researcher looked to learn more about the composition of the rammed earth and identified the team who worked on it. During an online interview, a volunteer architecture student, who had previously worked on the project shared, "The valuable expertise of Sunil, the worker on site, had already done the rammed earth construction, and we used his expertise and trusted him to mix the earth" (H. Weber, personal interview, April 20, 2024).

Dhoksan is located in a hilly area where the possibility of rain during the rainy season is heavy. Usually, the roofs in this area are slanted so that the rainwater flows down and does not affect the façade of the buildings. Nepal’s traditional architecture is incredibly well-suited to the region’s environment. It responds to local climatic materials and crafts conditions (Chandel et al., 2016). The roof form design for the rammed earth buildings was inspired by the traditional architecture of Bhaktapur’s

[13] Gada: a **bundle** or **unit** of something, often used to describe a specific quantity or measure of materials like straw, mud, or sand. It is commonly used in traditional construction practices and local farming to quantify items in a practical, informal way.

roof, which is thatch tiled, climate-responsive, and traditional structures incorporated in the rammed earth building roof.

The students who had come there to volunteer to build a building mentioned, “We asked the old man who lived in this village how to construct the traditional roof and what kind of roofs were built in Dhoksan” (A. Meyer, personal interview, April 20, 2024).

Furthermore, the old man had taught them about the type of roofs constructed and further suggested on the plan they had drawn where a volunteer architect had designed a pool, which the local people suggested to be aware of and consider the earthquake situation, causing the volunteers to remove the idea of a pool from their design.

However, the mud building adjacent to the rammed earth building had modern roofing, which did not protect the building from the rain. The worker who had worked in the construction mentioned,

Earlier, we had mentioned the architect involved in the project to extend the roofing projection to protect from the rain, but they were more focused on their design, which didn’t protect from the rain and hence, in the present, the mud house is impacted and requires a lot of maintenance.

The local people have a good knowledge of their context and surroundings as they reside there. The combination of past, present, and future makes the construction successful architecturally (Liauw, 2019),and the new design is compatible with local architectural style, allowing them to create a similar visual form of the built environment (Liauw, 2019). Hence, it emphasized the need to creatively incorporate well-known architectural features into new construction.

Local skills and knowledge are important, and the people in Dhoksan agreed that they need to include these in part of their school curriculum and teach new skills so that they are prepared to create job opportunities in their native land rather than go abroad. In the school in Dhoksan, the contextual chapters are introduced to the students, where they are focused on teaching the skills that help them provide employment opportunities in the future; hence, one of the teachers who teach in the school mentioned,

> Traditional skills are being taught to children in school such as knitting and stitching, which helps preserve these skills and integrate them into modern education. Likewise, children in Dhoksan are trained to cook traditional foods,

> as Dhoksan has more potential to become a tourist hub. Also, a second language English, is stressed to speak so they can communicate fluently with the foreigners. (T.Tamang, personal interview, April 20, 2024)

Apart from these skills, traditional building construction skills must also be introduced practically and theoretically in the school when asked to the local people living in Dhoksan.

One of the challenges of building in the hilly regions is the transportation. In the Dhoksan area, transportation of materials is difficult, and a lot of effort must be put into it. One of the architects, who was working on one of the sites mentioned,

> It was raining heavily, and since the Dhoksan is in a hilly area, the truck couldn't come up, so they had to load most of the materials from the downhill, and it was a difficult task for them. It is challenging to load the materials due to the context. (A. Braun, personal interview, April 20, 2024).

In addition, the terrain makes transporting construction materials impossible or unaffordable in most areas (Bhochhibhoya et al., 2017). There is a common misunderstanding that traditional methods are inferior or outdated, which can deter their use in favor of modern techniques and materials. One of the volunteer architects, Niraj, also mentioned, "In the case of mud houses, traditionally there was a lack of belief towards homes made from earth." Further, he added,

> However, after the negative perception, a positive outlook has emerged. It can be said that a traditional approach has also been used. The workers' confidence has increased, and they have upgraded their skills. Some have even gone abroad to work based on their experiences here.

In this way, the earth is an important natural element. Used for construction since ancient times, the earth is also reasonably priced and locally accessible at ease. Notwithstanding their labor-intensive nature and requirement for ongoing maintenance, raw earth methods have certain advantages. It eliminates the need for fossil fuels and CO2 because it does not require industrial processing and must only be transported a small distance. When used without cement or other industrial additions, earth is 100% recyclable and offers thermal comfort by keeping interior temperatures consistent with outside extremes (Dethier & Clarke, 2020). The local climate has greatly influenced the design of Nepal's traditional architecture. It represents the culture, habits, and lifestyles of the local community and adapts to the local climate, materials, and crafting conditions(Chandel et al., 2016).

Furthermore, using mud to construct new infrastructures in partnership with international organizations has given people faith that old building methods can still thrive and even support modern construction. For instance, the local people shared their knowledge of adding more cow dung to increase the strength of the mud (Lekshmi et al., 2020) and to avoid cracks in the mud while applying. The organization team showed a new possible way of building with bamboo and mud with improved design, a local construction technique in Nepal.

Improving rural infrastructure is more cost-effective than urban projects due to the labor-intensive nature of the work and lower wages in rural areas. It also promotes local employment and community involvement. Villagers can be motivated to contribute assets or labor if they believe it will benefit the community. The best option for sustained rural development is to build and develop villages in underprivileged rural areas (Zhang & Zhang, 2020). Sustainability in the context of the economy, society, and environment is typically associated with this concept.

Modern Construction Skills

Dhoksan has shifted to modern construction, especially after the 2015 earthquake. As most traditional houses were destroyed during this time, only a few are left here. Also, the government emphasized concrete structures more, which caused people in Dhoksan to start building with concrete rather than traditional methods. Also, the building codes for earthquake-resistant buildings emphasized concrete; hence, they convinced people to choose modern construction over traditional construction. One of the female workers, Mina, on the construction site who had previously worked there mentioned;

"The government had provided basic training on the construction, and I had participated in it. We were taught about laying bricks and plastering walls but not very advanced ones" (M. Tamang, personal interview, April 20, 2024).

Training in Dhoksan is limited to laying bricks and not more than that; if people know plumbing and welding, they do not need to search for people outside the village. The government needs to provide more training on quality construction, as demonstrated by the National Society for Earthquake Technology (NSET). NSET organizes programs for engineers and masons to teach earthquake-resistant construction and advise house owners on new construction. However, traditional methods of timber ties on all four walls have been misunderstood, leading to a decrease in the NSET School Earthquake Safety Program (SESP). This highlights the

need for better earthquake safety practices and modern construction methods (Dixit, 2004).

Similarly, Ramesh, who has been working with the local government on providing training on the health and safety for the workers in the construction field, mentioned,

"In Dhoksan, we have been training a few people interested in health and safety, and we teach them about personal protective equipment on site. Few people currently working on the site have taken training" (R. Tamang, personal interview, April 20, 2024).

These training programs align with the Labor Act's provisions for medical and injury-related treatment expenditures to ensure that workers receive the medical care they require, indicating a commitment to worker welfare that is likewise practiced on the job. Implementing the Labor Act 2017 and the Disaster Management Act 2017 emphasizes the vital role of worker safety and organizational accountability in reducing occupational dangers. Hence, these training and skills development among the local community is essential and have been practiced on-site on the few Dhoksan sites.

A few Dhoksan residents were interviewed, and during those conversations, they discussed the ongoing project in Dhoksan and shared that an international organization had proposed building a school and lodge there for the village's development. The locals worked with the international team because they believed this was an ideal chance to develop the village. When the researcher visited the project's location, she saw one foreign volunteer student working with locals to build the school. When questioned about the useful lessons her team had learned from the local knowledge, she replied regarding building earthquake-resistant foundations,

> "The Nepalese local workers on site shared their knowledge of construction techniques for the foundation, which they were aware of due to the more concrete construction in Nepal. Likewise, we learned how to make concrete, digging, stone, and how to make a whole foundation" (P. Adhikari, personal interview, April 20, 2024).

The international volunteers used distinct building skills during the process that distinguished them from the methods used in Nepalese buildings, as Ram on the site remarked; "Usually, the foreign volunteer team doesn't dig the whole ground but only digs which portion needs a foundation, which is quite different from how we

work in Nepal. This was a new learning for us while collaborating with them" (R. Tamang, personal interview, April 20, 2024).

Even though the team uses cement, they try to minimize its use. This process helps lessen the environmental impact and do the work more systematically rather than in an unplanned and haphazard way. Also, Dinesh, a local participant in one of these constructions, mentioned that the foreign team tried to use as much cement as possible. For instance, usually in Nepal, people use cement in the ratio of 1: 4 and 1: 5 for plaster, whereas they usually used in the ratio of 1:3, and it still worked effectively. These processes helped improve their skills and made them aware of the possibility of using less cement.

However, in the current scenario, we are more focused on building strong buildings to protect ourselves from earthquakes, blindly following the addition of cement and unnecessarily increasing the size of the pillar. However, on the site, working with people from abroad taught the villagers that they need to consider using materials in right proportion, as this can impact the environment. Hence, this has been a new addition to the modern skills of a few Dhoksan people involved on the site.

Similarly, new tools in the village helped to finish the work more efficiently on site in collaboration with the foreign architect. While the researcher was observing the construction site, the people used a nail gun to do the nailing, making their work faster. Similarly, Sunil, a local worker, shared that Nepalese people are usually more habituated to nailing directly on wood; however, while working with the foreign team, they first mark, make a hole, and then place the nail. Hence, through this process, they learned more to work on a clean and more accurate system. It also highlights that new machinery can improve efficiency and safety while working in construction. Hence, the new approach to using new materials to reduce environmental impact requires focusing on safety measures. Also, through this process, they realized the importance of planning over haphazardly deciding and working on it. These new practices must be followed in the village in the later days.

People in Dhoksan have learned to design and make windows and doors themselves rather than rely on buying from the market. The designs for four windows were intricate and not fully understood, emphasizing the importance of feasibility testing throughout prototyping. Shreya, a student from Germany working with Nepali workers, discussed the need to make the window prototype and know how to fix glasses on it.

> We didn't utilize a lot of materials.The knobs for the windows and doors were impossible to find in Nepal, so we created those ourselves. The prototypes were mostly made by the team using materials. Once the prototypes were completed, we assembled them in teams and demonstrated the process of the community. We explained both how we used the materials and why we chose them (S.Braun, personal interview, April 20, 2024).

A few females were also involved in the process, and they learned to weld and were more efficient than most of the males on the construction site. This encouraged them to work harder, and the males also applauded and encouraged them to work harder. One of the female workers who was involved in the welding, Sani, mentioned,

> I learned to wield on site along with Vishnu Devi and cut the glass through this process. I installed the glasses in the window using silicon and learned to do work with precision while laying the tiles. With the training, I can work for myself and develop ideas for the building structures (S. Tamang, personal interview, April 20, 2024).

This inclusive approach has set a precedent in the village, demonstrating that women can contribute equally to the workforce while building a socially active society. The men on the site encouraged Sani to work hard, especially when equal chances were given, and this was an excellent time to learn without feeling shy or hesitant. She added,

> This led me to learn the wielding, and I was appreciated for working more effectively and being skilled compared to the other men in the field. Hence, this kind of motivated me to work harder. In addition, no workers were discriminated against. All the works were given equal priority (S. Tamang, personal interview, April 20, 2024).

Usually, in Nepalese context, there is a high chance of less payment for the people cleaning on the site over people laying the bricks or welding. However, here, everyone was paid equally. In Nepal, women's salaries are generally 15% less than men's, even with equivalent training, education, and experience (Nguyen, 2012). Gender-based discrimination creates an economic disadvantage for women and has a significant influence on their employment (Nguyen & Tarp, 2022). Recent research has revealed that women's labor force involvement and economic standing are major determinants in shifting attitudes about gender equality, particularly among women

(Bolzendahl & Myers, 2004) a result, these programs encourage males to actively learn about gender equality (Nguyen & Tarp, 2022).

There was a decentralization of the skills, where the rotation of the work used to happen on-site, as everyone learned every skill, which also created an environment to develop the skills with the help of each other and learn mutually. The collaboration with the international organization brought a new perspective to the workplace, which aided in developing an equality mindset and new soft skills among the people of Dhoksan. This has led to the promotion of gender equality and helped create social cohesion.

Integrating workers and hearing their decisions let them feel more a part of the project while removing hierarchy on the site. It provides equal opportunity for them to think at the same level and take responsibility for what they are working on. Also, the participatory approach, incorporating people in the planning phase and later on-site, keeps them informed of their work updates from the start, making them feel like they are a part of it. This process simplifies the subsequent steps. This approach, used in self-construction building practices, encourages the community to use it in future projects instead of relying on foreign architects, who hand over the work and must complete everything themselves. Furthermore, the 2030 Agenda for Sustainable Development focuses on making choices with special reference to the participation of vulnerable groups such as women (SDG target 5.5), and it emphasizes how crucial it is for decision-making at all stages to be inclusive, participatory, and representative making rational choices.

Finally, integrating local knowledge and implementing training programs in initiatives like Dhoksan and Shiladevi Primary School show the value of community-based sustainable development approaches. By preserving traditional methods and embracing participatory approaches, these efforts promote cultural continuity and improve educational quality and community involvement. Furthermore, the emphasis on health and safety precautions, technological improvements, and skill decompartmentalization demonstrates a comprehensive approach to long-term growth. These initiatives help to achieve the 2030 Sustainable Development Goals by fostering local empowerment, decreasing environmental impact, and enhancing the well-being of individuals and communities engaged. Collaboration and information exchange enable more inclusive and resilient communities, prioritizing long-term sustainability.

Hybrid Construction

The use of both natural and recycled materials for the construction is considered a hybrid construction in this chapter. During the walk-and-talk interview, the community members agreed that using recycled materials for construction is also a form of modern construction. The construction process in Dhoksan has gradually changed over time. Previously, they had roofs constructed of slates or Chwali, and now we see corrugated sheets being used in the old traditional mud houses. Similarly, the timber beams are replaced with concrete pillars. Due to the cost and availability of local materials, Dhoksan gradually began to accept and use hybrid construction.

A few years ago, a school had become famous on social media because it used various natural and recycled resources. Many Kathmandu residents visited the school, which was built with donated bricks, mud, and recycled doors and windows. The school's rooftops were also covered in chwali. To gain a better understanding, the researcher met a worker who had previously been involved in constructing the donated brick structure. He later served as a volunteer at the school, where Hari noted,

> During the construction, we learned how to read the drawings. One needs to have a lot of patience to bring design to reality; this was a bit complicated. We realized that using the donated brick, we can build in a traditional design, and I am thinking of using this design to construct my residence in the near future (H. Tamang, personal interview, April 20, 2024).

With the acceptance of the school project built with recycled material, the same organization built another lodge project to develop Dhoksan. People in Dhoksan especially accept recycled materials like stone, bricks, and debris from the destroyed houses to construct new houses. Likewise, in Dhoksan, there is a new building built out of recycled materials and natural materials like bottles, plastic tiles, and local mud, bamboo, and rammed earth construction, which has become one example of the possible eco-friendly construction in Dhoksan which people often refer to. I also came across this building during field observation and walk-and-talk interview.

In one of the five buildings constructed as a unit out of rammed earth, mud was mixed using the kalimati mato (black clay); they mixed dust, stones, factory dust, and sand. In addition, leveraging local resources and capabilities is crucial for economic development through knowledge and innovation in production processes (Vázquez-Barquero & Rodríguez-Cohard, 2019).

This collaboration facilitated education among the Dhoksan community on natural and recycled materials, laying the groundwork for future community development initiatives (Braun & Okwako-Riekkola, 2018).

Also, these recycled bottle caps were crushed in one of the old traditional machines used for crushing corn in Dhoksan. These assistantships have also assisted the locals in Dhoksan in understanding and recognizing the possibilities of employing traditional skills, which has benefited them more in terms of health than cement, as well as being aware that the building may be created from recycled materials. Hence, this process has helped the people in Dhoksan and architects to share their expertise, perspectives, and ideas. This has made information sharing possible, enabling people to gain from one another and advance their abilities (Zamiri & Esmaeili, 2024).

In the same project, workers recommended using 1-inch thick vehicle tires (teu) beneath the roof for one of the building roofs, to protect against the sun and rain, responding to local climate conditions. This collaborative decision-making process demonstrates how involving workers in construction discussions bridges traditional gaps between professional roles, promoting a cohesive approach to project execution (Anderson & Crews, 2008). Embracing and integrating practical insights from the construction team fosters a cooperative environment that enhances project outcomes and teamwork.

Once, while the researcher was visiting Dhoksan, a team of architects in an under-construction kindergarten school project was seen to be drying wood chips in the sun. Out of curiosity, the researcher asked what it was used for, and one of the team members shared,

“In Germany usually, they use “Whaei” a byproduct of paneer production, mixed with wood chips for insulation, highlighting the potential for sustainable practices.”

The amalgamation of the foreign architect’s modern knowledge and Nepali workers’ local resource knowledge facilitated the successful implementation of these techniques. Furthermore, in the future, with crucial support from the government, community members will be equipped to undertake projects independently, given their awareness of climatic resilience to climate risks and capabilities developed through collaborative processes (Jensen & Ong, 2020).

The people in Dhoksan learned to build out of recycled materials collected from the nearby Dhasingpuwa and Nagarkot areas, where they brought a truck and

delivered a sack of bags to each residence. Similarly, while collecting the plastics, Dip, a local laborer, stated,

> Plastic from Wai Wai noodles and lays packs are unacceptable because they contain sparkly materials. Also, oil plastic, plastic bottles such as mineral water, soda, and dew bottles dissolve, but they are highly liquid and weak, making them unsuitable for producing tiles (D. Tamang, personal interview, April 20, 2024).

A foreign architect of the organization stated, “Thermoplastic tiles are beneficial to the manufacturing process of plastic tiles.” (L. Braun, personal interview, April 20, 2024). She went on to explain that daily plastic is thermoplastic. Furthermore, Ram, a local worker, discussed the procedure of creating tiles, “First, open the plastic and then clean it in a large vessel by boiling it. This method is challenging since people frequently have trouble breathing due to smoke.” (R. Tamang, personal interview, April 20, 2024).

Also, one of the female workers added that people working in the plastic cleaning station usually would be sick the other day. Similarly, Liz stated,

> Masks were provided due to the fumes problem, but the environment was still harmed, and for future large tests, they raised funds and purchased recycling materials to make a tile of the size. Moreover, making four plastic tiles would take around 30 minutes. Usually, in this process, they first pour over the liquid, and in a machine, they make a gun degree, and then mold has to be made out of metal (L. Braun, personal interview, April 20, 2020).

Though this process was researched and introduced to the people in Dhoksan, it was only limited to the specific project. The teaming up among the local workers and making it a business could have been a new employment opportunity for the people. This also hints that the people in Dhoksan rely more on the funds and financial resources provided by the international organization and less initiated due to the funding limitation. Collaborating with local governments is crucial for addressing solid waste management. The Solid Waste Management Act of 2011 encourages private sector construction and operation of recycling facilities and landfills, as long as they follow relevant laws. Sections 14 and 15 discuss public-private partnerships for waste reduction, collection, and recycling and competitive bidding for contracts based on environmental sustainability and technological capability. Hence, a collaboration with the local government would be a good initiation to take it forward.

The hybrid construction skills have empowered local participants and created a platform for equal learning on-site, similar to how the government provides a training program in which workers are paid more than regular wages on-site and teaching on-site. In the future, this collaborative effort will make it easier to launch more initiatives without relying on foreign aid, instead partnering with the local government and community people to grow the town. They do not need to build infrastructure from the start and can still interact with and support local governments independently. The community is aware of the method and approach, and as a result, community planning and development can occur even with less effort, thereby establishing an environment.

Language has been a challenge during the collaboration process because new team members are rotated every six months, bringing a diverse language to the site. This exposure to other languages motivated the school principal to prioritize English language education. Typically, government schools in Nepal struggle with English competency. To solve this, the school hires external English teachers weekly to improve foreign language communication and students' job possibilities.

Recently, the government has stressed the need to incorporate local knowledge into students' curricula, focusing on teaching about their surroundings and practical skills such as making authentic local cuisine for tourists. This effort intends to train youngsters at an early age in skills that will open up new work opportunities while promoting education. This approach has driven schools to look into curriculum development options, including the incorporation of local knowledge and practical skills in order to make students ready for the labor market and increase overall educational quality.

Chapter Summary

This chapter discussed the skills of local people living in Dhoksan in three aspects: traditional, modern, and hybrid. It emphasized the vitality of local people's knowledge of the local resources and understanding of the soils and the mix compositions that contribute to sustainable construction practices. It also emphasized mixing mud with straw and cow dung, which can be incorporated into modern education to create a job opportunity. Further, it discussed the challenges of transporting materials in hilly regions and the shift towards concrete structures following the 2015 earthquake, driven by government regulations for earthquake-

resistant buildings. The chapter demonstrated the partnership between local workers and international volunteers, focusing on efficient and environment-friendly practices.

An important discovery was the introduction of hybrid construction skills, whereby traditional methods are adapted to modern design practices through the collaboration and assistantship of local participants and international volunteers.

These findings will form a base for the discussion chapter, which will delve deeper from the lens of five pillars of sustainability, encompassing environmental, social, cultural, economic, and political.

CHAPTER VI
DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

This chapter explores how modern and traditional building methods can coexist with the natural and recycled building materials in the setting of Dhoksan. It is framed by the five pillars of sustainability – environmental, social, economic, cultural, and political. The discussion examines how this approach contributes to minimizing the ecological impact of the construction industry. It highlights the importance of connecting traditional construction methods with contemporary practices, exploring how sustainability and cultural preservation intersect, and showcasing the transformative potential of sustainable development.

Discussion

In this demanding context, natural building and recycled material constructions are being discussed as alternative solutions for minimalizing the ecological impact of the building and construction industry. Cities can achieve sustainable development by reusing waste and recycling materials, also considered important indicators of environmental dimensions (Zen et al., 2012). Likewise, Davidson (2019) emphasizes that adopting sustainable construction practices is not just important but urgent. The construction sector emphasizes these needs as a leading cause of environmental degradation, primarily due to the extensive use of cement. Cement production significantly impacts health and the environment by releasing dust, carbon dioxide, nitrogen oxide, and sulfur dioxide, irritating the eyes, nose, throat, and upper respiratory system (Salah et al., 2023).These environmental concerns have increased interest in alternative, more sustainable building materials and methods.

In response to these challenges, natural materials like mud and stones offer a low embodied energy and low embodied carbon alternative to conventional building materials such as concrete and steel (Woolley , 2007). This is supported by observation from an international student who noted that using wood is emphasized in the school construction in Dhoksan as it consumes less CO2, and the traditional methods are sustainable. Additionally, adopting local materials in construction can decrease energy consumption by up to 215 percent and the impact of transportation by

453 percent (Morel et al., 2001). Furthermore, by adopting local materials, we reduce costs and support local employment and energy efficiency, which aligns with SDGs. This parallels with the traditional building construction practice in Dhoksan, which is crucial for establishing a harmonious relationship between human activities and the environment, ultimately fostering sustainable living.

The integration of traditional building techniques with modern construction methods not only highlights sustainability but also celebrates local craftsmanship and heritage. This approach fosters a deeper connection between architecture and its surroundings, emphasizing the importance of creating built environments that resonate with their context while addressing contemporary challenges such as waste management and environmental impact. Moreover, the iterative nature of architectural design, as demonstrated in the adaptation of the bottle house project, highlights the flexibility and responsiveness required to achieve safety, sustainability, and community engagement in construction. By prioritizing these aspects, architects and designers can foster meaningful dialogue with local communities, empower sustainable practices, and ultimately contribute to a more resilient and harmonious built environment that aligns with society's evolving needs and values.

From the perspective of social sustainability, this also facilitates social cohesiveness and participatory decision-making. Throsby (2017) argues that integrating traditional knowledge with modern techniques offers an opportunity for knowledge transfer from one generation to another, preserving cultural heritage in the face of modern issues. In Dhoksan, for instance, the locals' involvement in the planning and construction of buildings through the use of both traditional and modern approaches has increased social capital and created a sense of local ownership over development initiatives. This is consistent with the idea of social sustainability put out by Eizenberg and Jabareen (2017), which highlights the value of safety, equality, and environmental consciousness in building resilient communities.

Furthermore, traditional building construction often integrates these informal disaster protection measures while serving social functions. Ghimire believes modern architecture may serve people by improving social systems and mitigating natural calamities. Ram emphasizes the usage of vernacular-style houses with open spaces as evacuation routes during earthquakes. Traditional building construction frequently contains informal disaster protection measures. The building arrangement enables inhabitants to interact and communicate. Traditional dwellings often feature semi-

open areas, such as 'chedi,' for domestic usage and the cooking of local foods. These areas are also hubs for community events, which fosters community spirit. The study emphasizes the role of informal disaster avoidance in traditional building construction, demonstrating how traditional design improves social systems and communication among residents.

The inclusion of women in the construction industry contributes to gender equality and a more socially sustainable society. Through the construction activities on site, it dismantles gender stereotypes in the building sector and fosters a welcoming community. This aligns with Dempsey et al. (2011)use of Leonard's (2011) social sustainability model, which considers community continuity and social equality. The social network grows, and decision-making becomes more well-rounded as more women work in various departments on construction sites, such as welding, plastering, and laying tiles. Furthermore, women are more likely to positively impact family welfare, education, and community health outcomes when they become economically independent and pick up new skills (Kabeer, 2005). However, challenges remain in providing equal access to education and training in natural building techniques.

However, Nepal faces a significant gap in formal training for natural materials building, with education primarily focusing on modern techniques. This is particularly concerning for women, who often face barriers to accessing such education (Acharya, 2001). Dhoksan offers an inclusive learning environment that combines traditional knowledge with new tools and perspectives, enhancing natural construction practices and providing a platform for women to broaden their perspectives in a traditionally male-dominated field. This approach could lead to more resilient, culturally appropriate, and gender-inclusive building practices, potentially fostering innovation and novel solutions for sustainable development in Nepal.

Beyond their social and safety benefits, these materials also offer economic advantages that align with cultural preservation and modern sustainability goals. Using local materials is more economical than buying imported construction materials and contributes to building affordable housing (Oladiran, 2015). For instance, Paro Bas, which is readily accessible, costs around NPR 200. Similarly, the costs of materials like mud like Peri Mato and Kali Mato from Bhaktapur and donated bricks were negligible; only the transportation costs were required, which were lesser than getting the materials from Kathmandu. Ejiofor and Chiedozie (2023) support this

perspective, noting that using local materials reduces construction costs, with durability and production costs being the most significant factors.

The path to sustainable development is possible by integrating modern technology with traditional building methods, particularly in the context of eco-tourism. This process can help to lead sustainable eco-tourism by integrating vernacular architecture, which not only enhances the comfort of tourists (Ghasemi, 2017)but also supports sustainable development (Martínez Quintana, 2021). For instance, implementing a compost toilet can mitigate the water problem in Dhoksan, particularly as the number of tourists increases. This approach aligns withAli et al.'s (2020) perspective that sustainable tourism should minimize negative impacts on environmental resources and social culture.

Moreover, this strategy resonates with the Columbian concept of "buen vivr," which emphasizes communal well-being and sustainable living in harmony with the environment (Gudynas, 2011). Reinforcing historic wooden lintel bands to improve structural integrity shows the possibility of integrating traditional knowledge to solve contemporary challenges. This promotes respect for natural and cultural heritage while fostering local development (Martínez Quintana, 2021).

However, preserving and integrating traditional practices into modern construction face significant challenges. The locally available materials and voices from the bottom are rarely documented at the policy level and academic sectors for policy implementation (Acharya & Sharma, 2023). This neglect has led to the gradual disappearance of traditional houses in Dhoksan, where only a few remain after the earthquake due to the dominance of modern development trends (Bodach et al., 2014). This situation highlights the disconnection between community resources and local value systems in the overall development strategies of the village development.

Furthermore, the gap in utilizing local knowledge practices in formal and informal institutions (Acharya & Sharma, 2023)hinders the effective implementation of these practices in sustainable development strategies. By recognizing and valuing local knowledge, we can develop more inclusive and context-specific approaches to sustainable construction, allowing communities to maintain their cultural heritage while adapting to new challenges.

Modern infrastructure and urbanization are at risk in Dhoksan due to the growing dominance of modern development trends which have led to the erosion of traditional social structures and safety measures. Strong ties and healthy communal

spaces have disappeared as a result of this. The government should implement land use planning in response to popular demand, integrating traditional concepts with contemporary urban planning to capitalize on the social and safety advantages of vernacular architecture. This approach is consistent with the notion put forth by (Berkes et al., 2000) of integrating traditional knowledge systems with modern resource management systems.

Integrating traditional and scientific knowledge can provide better adaptation opportunities for the local people, particularly in the context of climate change. Swart et al. (2003) argue that sustainable management is crucial to climate change mitigation and adaptation. By incorporating local knowledge into climate change policies, we can develop cost-effective, participatory, and sustainable adaptation measures that resonate with the needs and values of the communities (Robinson & Herbert, 2001).

A practical example of this integration can be seen in Dhoksan, where the foreign volunteers collaboratively work with the local people, integrating the traditional knowledge of the soil composition to build the mud house and, similarly, using modern scientific techniques to make a series of these test by volunteers before implementing on site. This approach demonstrates that traditional knowledge does not compete with modern scientific approaches; rather they complement each other, enhancing the overall effectiveness of climate adaptation strategies (Nyong et al., 2007). This collaborative nature enhances community resilience and creates a better knowledge of the interconnection between human activities and the natural environment.

The increasing difficulties brought about by climate change emphasize the need for incorporating traditional knowledge into contemporary actions even more. The Intergovernmental Panel on Climate Change (IPCC) 2007 has highlighted the vulnerability of natural and social systems to climate for integrating traditional knowledge into climate change policies and implementation (Makondo & Thomas, 2018).As a result, this study established the foundation for figuring out the design approaches employed by Nepalese traditional architecture.

More investigation is required to adapt these traditional approaches to the modern context and create suitable construction methods for the nation’s rapidly growing construction industry(Bodach et al., 2014). Communities may reduce floods and structural damage by improving urban drainage and encouraging routine building

maintenance, which will help create a more resilient environment(Forbes, 2018). Ultimately, combining traditional and modern building methods can result in a sustainable future that respects cultural legacy while tackling the most critical issues of the twenty-first century.

Incorporating traditional building principles into modern construction represents sustainability, local artistry, and the past. This technique improves the interaction between architecture and its surroundings, ensuring that space is evocative and responsive to current demands. The iterative method of architectural design allows the bottle home project to demonstrate flexibility, safety responsiveness, sustainability, and community engagement. This technique allows architects and designers to engage with local communities, unlock true sustainability, and create a more resilient and harmonious built environment.

Integration of Traditional and Modern Skills

Almost one-third of all the waste in the country is construction waste, which significantly impacts the environment. Papadaki et al. (2022)and Bonoli et al., (2021) emphasize that effective recycling of building materials can dramatically reduce the construction sector's environmental impact and mitigate its negative effects. This is evident in Dhoksan, where projects using bottles, plastic tiles, and donated bricks have showcased creative strategies for turning waste into valuable building components that reduce the demand for new materials and support sustainable goals. Such an approach helps extend the life of landfill sites by reducing waste, minimizing environmental health risks, and reducing construction costs, illustrating the social and environmental benefits of innovative recycling practices (Lingard et al., 2000). Nevertheless, while Dhoksan's efforts showcase a proactive approach to sustainability, expanding these initiatives more broadly faces significant market development and industry adoption challenges.

The low market developments require significant investment in building relationships, monitoring pricing changes, and becoming a reliable material supplier to ensure a consistent supply of construction materials (Begum et al., 2006). However, MacDougall (2008) argues that the majority of the building industry's inexperience using these materials and the absence of scientific data are still obstacles that need to be overcome. Contradicting Mac Dougall's claim, the experience in Dhoksan demonstrates that people, for instance, are aware of their traditional building methods. Still, they also collaborated with an international organization to use modern

techniques, showing that they were willing to grow and learn despite these difficulties for the development of their village. This willingness to learn and grow for the development of the village showcased that the communities can mitigate the problem of using sustainable materials by leveraging both local and modern skills. As a result, this method facilitated the sharing of traditional and modern skills, which helped each other achieve the shared goal of building overall sustainability.

This educational adaption at Dhoksan's school reflects what Kioupi and Voulvoulis (2019) define as Education for Sustainable Development (ESD). More vital English language programs have been developed to address the needs that have traditionally been part of the local culture and the emerging opportunities created through international collaborations. Local knowledge of knitting and cooking has been incorporated into the school curriculum. This approach reflects the focus in the ESD framework on contextual adaptation and connecting global sustainability goals to local educational outcomes since it not only protects cultural knowledge but also creates pathways for sustainable livelihoods.

Furthermore, the educational partnerships between traditional knowledge and modern construction practices(Folke et al., 2005)propose to foster social learning and the development of adaptive capacity. The strategy used by this school also demonstrates how educational institutions can successfully foster social capital and community resilience by supplying the values, information, and abilities needed to overcome interconnected and globally relevant problems that are attached to local contexts. The inclusive approach to education in Dhoksan demonstrates how schools may significantly contribute to sustainable community development and puts the ESD principles into practice.

The collaborative environment fostered mutual learning between the locals and volunteers, where the volunteers also learned about the composition of materials and the context-based design from local people. Using local materials like ‘Chimti Mato’ and bamboo proved crucial in reducing the environmental and economic impact. The selection of materials can help reduce CO2 emissions by 30 percent, preventing the release of 38 tons of CO2 (Thormark, 2006). Additionally, Pacheco-Torgal and Jalali (2012)highlight that such choices can lead to a 17 percent reduction in energy consumption for buildings. By switching to natural and renewable building materials, we can create a sustainable, carbon-neutral future that preserves our fragile ecosystem and improves the economy.

In the conversation with community members, they shared that managing communal garbage and generating something out of it are modern skills, as they believed that using and developing new technologies is part of modern skills. Similarly, using natural materials to create and construct one's house is considered a modern skill. This suggests the combination of interest in modern methods that contribute to environmental sustainability and technological advancement. Despite their receptiveness, the community supports traditional techniques, which they consider essential to their cultural identity. Hybrid approaches are preferred because they combine modern construction techniques with traditional building materials like bamboo and mud to improve sustainability and cultural preservation. This respect for traditional methods combined with an awareness of the practical benefits of modern construction techniques implies that a balanced approach can result in increased adoption and acceptance of sustainable practices.

The findings of the study suggest that the development of a sense of community and interpersonal relationships among the people of Dhoksan was facilitated by the use of traditional building methods and the "Aicho paicho" system of mutual aid. However, as modern building techniques advance, these traditional support solutions may become more difficult to use alone. Social cohesiveness and community resilience need to figure out how to maintain these traditional customs while adapting them to the modern world (Putnam, 1995). Creating contemporary building designs without sacrificing traditionalism is the complex part. For example, supported self-help housing is a concept in which community members participate actively in the building process, bringing both traditional and modern kinds of support.

The integration of traditional and modern skills has also empowered the local community. The women's participation stands at 26.3 percent, slightly less than half that of men at 53.8 percent, according to Nepal’s 15th Five-year periodic plan developed by the National Planning Commission. Likewise, the country’s sustainable development efforts are hindered by a lack of representation of women in various aspects, including economic, social, political, and environmental areas (Bayeh, 2016). In Dhoksan, this is evident as the female participation in construction was less, and while visiting sites for interviews, women were involved in cooking food for their lunch. However, a few women involved in the site shared that they are empowered by getting involved in the work that usually men do, like welding or construction work.

They noted that the rotational work approach helped them gain confidence and support from their male colleagues. Usually, women's rights are not adequately protected, and their participation in various issues is often subjected to violations(Bayeh, 2016). However, one construction site in Dhoksan practiced equal pay for men and women, contrasting with the typical 15 percent gender pay gap reported elsewhere (Gallup, 2002; Nguyen, 2012). This also helped the women to be more empowered financially.

Nepal government is promoting sustainable waste management to mitigate the detrimental effects of solid waste on public health and the environment. However, there are no clear guidelines for the reuse of salvaged materials and alternative construction materials (HRRP Nepal, 2023), posing challenges to implementing sustainable practices in construction. Adopting natural and recycled construction technologies causes various favorable changes from a sustainability standpoint. It minimizes environmental effects by reducing resource use and carbon emissions while encouraging trash reduction and recycling. This also addresses the 2030 aim of promoting the 3R (Reduce, Recycle, and Reuse) approach to waste management and source segregation and management of degradable and non-degradable waste by the Second Nationally Determined Contribution, 2020.

Moreover, adapting national and building norms and supporting the creation of integrated urban development plans can be prioritized by focusing on recycled and natural construction. The plan aims to encourage climate resilience in urban and low-carbon urban settlements throughout all municipalities. Futhermore, by 2025, the standards for urban environment management will be updated, including initiatives for the development of low-carbon and climate resilience urban communities (Government of Nepal, 2020).

Although there are some targets to achieve sustainable development in practice, there are not enough implementations to meet them, and they appear unachievable. During the field observation, it was visible that most of the houses in Dhoksan were built using a combination of RCC and mud-bonded bricks. Most houses have galvanized sheets, and some have reinforced cement concrete. Similarly, the majority of the houses are cemented, and some of them have mud floors. It was noticeable how the landscape of building construction has changed in Dhoksan, where people are building cement houses using local natural materials because of the

government's greater emphasis on cement construction for stability after the earthquake in 2015.

Upon discussing the measures for the preservation of traditional skills and cultures, the majority of participants shared that government incentives and subsidies highlight the need for financial support to sustain these practices. Some of them also shared how education and training programs are required to pass down new skills to the new generation to promote traditional knowledge (Radzuan et al., 2017). Therefore, the study reflects the importance of collaboration between traditional and modern builders, which suggests a forward-thinking approach that respects heritage while embracing innovation(Djabarouti & O'Flaherty, 2020). It is high time to think about creating market demand for traditional craftsmanship, suggesting this thrives in the competitive market and public awareness campaign. Furthermore, if the government could further showcase successful traditional projects, it could help foster a supportive community environment for traditional practices. Additionally, the government needs proper land use planning to make it more sustainable.

Achieving sustainability requires a holistic approach, including host government policies, active community engagement, ecological integrity, and sufficient financial resources. The fundamental concepts of sustainable development – ecological economics, natural capital, and eco form- emphasize how difficult it is to balance resource preservation and urban growth (Jabareen, 2012). A multidisciplinary approach that considers ethical, social, economic, and environmental concerns is necessary to understand sustainability.

In this context, it becomes evident that understanding sustainability necessitates a multidisciplinary approach. This review points out fresh theoretical views, methodological issues, and relevance in various situations while identifying gaps in previous material. Moreover, it critically examines the practical applicability of these theoretical underpinnings in organizational practices, policy formulation, and decision-making within sustainability. This offers invaluable insights for forthcoming sustainability-oriented projects.

Conclusion

The insights drawn from this Dhoksan study extend far beyond house building. True sustainability cannot be reduced to problems of eco-friendly materials or modern procedures but rather necessitates a balance of traditional and modern, tradition and innovation, and the locally known and the globally understood.

However, the Dhoksan example reminds us that when respect for local knowledge and active community participation is the approach, it is feasible to produce solutions that are environmentally friendly, culturally meaningful, economically profitable to individuals and communities, socially viable, and hence sustainable. The strategy also improves and enhances the community's buildings, preserves its cultural legacy, and strengthens society.

The Dhoksan case represents the community model in sustainable development. Here, every resident serves as both apprentice and master; the process is similar to traditional apprenticeship institutions but on a far larger scale. This method touches all five pillars of sustainability--environmental, social, economic, cultural, and political--before revealing a sixth pillar: educational sustainability.

This model offers valuable lessons for communities worldwide who struggle with modernization while retaining their unique identity. How can we grow and build without destroying the environment for tomorrow? Dhoksan's approach to these difficulties provides valuable lessons for other similar terrain villages and cities, legislators, and development specialists. It also challenges conventional top-down models for development and advocates for a bottom-up participatory strategy in which local information is valued and integrated with global perspectives.

Perhaps most importantly, this study reminds us that sustainable solutions can originate from any source. This is certainly one that violates traditional knowledge, as development has typically been associated with abandoning traditional methods in favor of modern ones. On the contrary, what is stressed here are the benefits of integrating traditional and modern, local and global, to provide innovative and long-lasting solutions. In the face of global issues like climate change and rising urbanization, this adaptable, community-centered approach could be the key to creating a more sustainable and equitable society.

To summarize, Dhoksan's narrative is one of anticipation and practical wisdom. The research demonstrates that communities may carve their way to a more sustainable future by being resourceful, respectful of traditional knowledge, and open to new learning opportunities. The procedures may be slower and heavier than those proposed above and through uniform solutions, but the results are more profound and long-lasting. Perhaps, with these lessons in mind, we will be able to develop a better, more sustainable society in the future that can help us combat climate change and strategies to develop many parts of Nepal.

Implication of the Study

The findings of the Dhoksan study on building construction with recycled and natural materials can significantly benefit the communities in Benighat Rorang Rural municipality. Beninghat is in a hilly region with terrain similar to that of Dhoksan. The Municipality is located in the South Western Region of Dhading District in Bagmati province, Nepal. It has a population of 33854, according to the 2021 Census conducted by the Central Bureau of Statistics. The municipality is rural and is located in an area with limited access to modern infrastructure. The area is home to a diverse range of ethnic groups, including Brahmin, Chettri, Thakuri, and Rajput, who make up 49.39 percent of the population, and various indigenous nationalities account for 28.37 percent. The Chepang community is the majority among the Indigenous groups, followed by Magar, Tamang, Gurung, Dalit, Brahmin, and Chhetri in mixed accounts.

The study shows that using local materials helps in reducing transportation costs, and the community might consider constructing buildings using those materials. Using these resources is helpful in times of landslides and floods when they have to reconstruct the buildings without anyone's support, so using natural materials would make more sense. Also, the use of wooden tie beams and the way the buildings are built in Dhoksan can be followed by the communities of Benighat. Similarly, regarding the use of recycled materials in building construction, both areas face the problem of waste management, and Dhoksan utilized its waste for the building construction. Though the initial process is a bit hectic, strategizing by teaming with local people and the local government can help install the machines and train the local people to use these materials for the building construction in Benighat as they are reducing a lot of waste.

The study’s findings from Dhoksan highlight the significant benefits of integrating natural and recycled materials in building construction from communities like Benighat Rorang Rural Municipality. The utilization of locally available materials not only preserves the cultural heritage but also enhances the structural integrity of buildings, making them more resilient to the natural disasters. Additionally, considering the management of the waste by incorporating in the building also promotes economic viability and sustainability. By implementing training programs and empowering local workers, the community can develop sustainable building practices that reduce environmental impact and improve resident’s livelihoods. This approach not only fosters a circular economy but also

ensures the constructions respect the traditional architecture and meet the practical needs of people, providing sustainable development, benefits, and assurance.

REFERENCES

Acharya, B., & Sharma, D. P. (2023). Ignorance of local needs in construction of new houses of the earthquake hit Dalit community in central Nepal. *Namuna Academic Journal*, *2*(2). https://doi.org/10.3126/naj.v2i2.58797

Ackerschott, A., Kohlhase, E., Vollmer, A., Hörisch, J., & von Wehrden, H. (2023). Steering of land use in the context of sustainable development: A systematic review of economic instruments. *Land Use Policy*, *129*. https://doi.org/10.1016/j.landusepol.2023.106620

Ali, F., Lintang Lestari, D., & Dyasthi Putri, M. (2020). Eco-friendly toilet for sustainable wastewater management in tourism area. *E3S Web of Conferences*, *211*. https://doi.org/10.1051/e3sconf/202021101009

Allouhi, A., El Fouih, Y., Kousksou, T., Jamil, A., Zeraouli, Y., & Mourad, Y. (2015). Energy consumption and efficiency in buildings: Current status and future trends. *Journal of Cleaner Production*, *109*. https://doi.org/10.1016/j.jclepro.2015.05.139

Anand, C. K., & Apul, D. S. (2014). Composting toilets as a sustainable alternative to urban sanitation - A review. *Waste Management*, *34*(2). https://doi.org/10.1016/j.wasman.2013.10.006

Anderson, D., & Crews, K. (2008). *Bridging the gap – A design process case study for an "intelligent" footbridge*. https://doi.org/10.2749/222137808796106332

Aneke, F. I., & Shabangu, C. (2021). Green-efficient masonry bricks produced from scrap plastic waste and foundry sand. *Case Studies in Construction Materials*, *14*. https://doi.org/10.1016/j.cscm.2021.e00515

Audefroy, J. F. (2011). Haiti: Post-earthquake lessons learned from traditional construction. *Environment and Urbanization*, *23*(2). https://doi.org/10.1177/0956247811418736

Bajracharya, S. B. (2014). The thermal performance of traditional residential buildings in Kathmandu valley. *Journal of the Institute of Engineering*, *10*(1). https://doi.org/10.3126/jie.v10i1.10898

Baulch, B., Weber, A., & Wood, J. (2008). Social protection index for committed poverty reduction. *Asian Development Bank2*,(030908).

Bayeh, E. (2016). The role of empowering women and achieving gender equality to the sustainable development of Ethiopia. *Pacific Science Review B: Humanities and Social Sciences*, *2*(1). https://doi.org/10.1016/j.psrb.2016.09.013

Begum, R. A., Siwar, C., Pereira, J. J., & Jaafar, A. H. (2006). A benefit-cost analysis on the economic feasibility of construction waste minimisation: The case of Malaysia. *Resources, Conservation and Recycling*, *48*(1). https://doi.org/10.1016/j.resconrec.2006.01.004

Belabid, A., Akhzouz, H., Elminor, H., & Elminor, H. (2023). Characteristics of traditional building materials and techniques based on earth, stone and timber: An overview and focus on Morocco. *Journal of Engineering Research and Technology*, *10*(3).

Bell, S., & Morse, S. (2012). Sustainability indicators: Measuring the immeasurable? Second edition. In *Sustainability Indicators: Measuring the Immeasurable? Second Edition*. https://doi.org/10.4324/9781849772723

Ben-Alon, L., Loftness, V., Harries, K. A., & Cochran Hameen, E. (2021). Life cycle assessment (LCA) of natural vs conventional building assemblies. *Renewable and Sustainable Energy Reviews*, *144*. https://doi.org/10.1016/j.rser.2021.110951

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*,*10*(5). https://doi.org/10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2

Bharali, B., Rajbanshi, B., Yangzom, T., Dahal, H., Rai, M., & Sewa, B. (2021). Promoting Sustainable Housing with Fundamental Shift beyond Net-Zero and Green Building. *EGU General Assembly Conference Abstracts*.

Bhattarai, B., Chimoriya, D., & Singh Bhattarai, B. (2023). Green building approach towards achieving sustainability in Nepal. *American Journal of Modern Energy*. https://doi.org/10.11648/j.ajme.20230902.11

Bhochhibhoya, S., Zanetti, M., Pierobon, F., Gatto, P., Maskey, R. K., & Cavalli, R. (2017). The global warming potential of building materials: An application of life cycle analysis in Nepal. *Mountain Research and Development*, *37*(1). https://doi.org/10.1659/MRD-JOURNAL-D-15-00043.1

Bodach, S., Lang, W., & Hamhaber, J. (2014). Climate responsive building design strategies of vernacular architecture in Nepal. *Energy and Buildings*, *81*. https://doi.org/10.1016/j.enbuild.2014.06.022

Bolden, J., Abu-Lebdeh, T., & Fini, E. (2013). Utilization of recycled and waste materials in various construction applications. *American Journal of Environmental Sciences*, *9*(1). https://doi.org/10.3844/ajessp.2013.14.24

Bolzendahl, C. I., & Myers, D. J. (2004). Feminist attitudes and support for gender equality: Opinion change in women and men, 1974-1998. In *Social Forces* (Vol. 83, Issue 2). https://doi.org/10.1353/sof.2005.0005

Bonoli, A., Zanni, S., & Serrano-Bernardo, F. (2021). Sustainability in building and construction within the framework of circular cities and european new green deal. The contribution of concrete recycling. In *Sustainability (Switzerland)* (Vol. 13, Issue 4). https://doi.org/10.3390/su13042139

Bothara, J. K., Dhakal, R. P., Ingham, J. M., & Dizhor, D. (2016). The challenges of housing reconstruction after the April 2015 Gorkha, Nepal earthquake. *Technical Journal of Nepal's Engineers Association, October*. https://www.researchgate.net/publication/309188369_The_Challenges_of_Housing_Reconstruction_after_the_April_2015_Gorkha_Nepal_Earthquake

Braun, A. M. B., & Okwako-Riekkola, B. (2018). Ujamaa and universal design: Developing sustainable tactile curricular materials in rural Tanzania. *Disability, CBR and Inclusive Development*, *29*(2). https://doi.org/10.5463/DCID.v29i2.686

Broniatowski, D. A., & Weigel, A. L. (2006). Political sustainability in space exploration architectures. *Collection of Technical Papers - Space 2006 Conference*, *2*. https://doi.org/10.2514/6.2006-7310

Brundiers, K., Barth, M., Cebrián, G., Cohen, M., Diaz, L., Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., & Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science*, *16*(1). https://doi.org/10.1007/s11625-020-00838-2

Bryman, A. (2012). Social research methods Bryman. *OXFORD University Press*, *4th Edition*.

Burnard, M. D., Nyrud, A. Q., Bysheim, K., Kutnar, A., Vahtikari, K., & Hughes, M. (2015). Building material naturalness: Perceptions from Finland, Norway and Slovenia. *Indoor and Built Environment*, *26*(1). https://doi.org/10.1177/1420326X15605162

Caring for the Earth: A strategy for sustainable living. (2013). In *Caring for the Earth: A Strategy for Sustainable Living*. https://doi.org/10.4324/9781315066073

Castilla, F. J., Agulló, J., & Castellote, J. (2020). Characterization and proposals for recovery of traditional tamang construction in northern Nepal. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, *54*(M–1). https://doi.org/10.5194/isprs-archives-XLIV-M-1-2020-115-2020

Chan, A. P. C., Darko, A., & Ameyaw, E. E. (2017). Strategies for promoting green building technologies adoption in the construction industry-An international study. *Sustainability (Switzerland)*, *9*(6). https://doi.org/10.3390/su9060969

Chandel, S. S., Sharma, V., & Marwah, B. M. (2016). Review of energy efficient features in vernacular architecture for improving indoor thermal comfort conditions. *Renewable and Sustainable Energy Reviews,65*, 459-477. https://doi.org/10.1016/j.rser.2016.07.038

Chou, S., & Austin-Breneman, J. (2018). Prototyping methods and constraints for small-to-medium sized enterprises in East Africa. *Development Engineering*, *3*. https://doi.org/10.1016/j.deveng.2018.05.002

Ciancio, D., Jaquin, P., & Walker, P. (2013). Advances on the assessment of soil suitability for rammed earth. *Construction and Building Materials*, *42*. https://doi.org/10.1016/j.conbuildmat.2012.12.049

Clarke, V., Braun, V., Hayfield, N., & Terry, G. (2019). *Thematic analysis (Liamputtong P.Eds). Handbook of Research Methods in Health Social Sciences*.

Cope, M. (2017). Transcripts: Coding and Analysis. *International Encyclopedia of Geography*. https://doi.org/10.1002/9781118786352.wbieg0772

Creswell, J. W. (1998). Qualitative inquiry and research design: Choosing among five traditions. In *Qualitative Health Research* (Vol. 9, Issue 5).

Dabaieh, M., Maguid, D., & El-Mahdy, D. (2022). Circularity in the new gravity—Re-thinking vernacular architecture and circularity. *Sustainability (Switzerland)*, *14*(1). https://doi.org/10.3390/su14010328

Dadi, G. B., Goodrum, P. M., Taylor, T. R., & Maloney, W. F. (2014). Effectiveness of communication of spatial engineering information through 3D CAD and 3D printed models. *Visualization in Engineering*, *2*(1). https://doi.org/10.1186/s40327-014-0009-8

Das, J. K., & Bharali, B. (2022). A simplified numerical approach to predict bearing capacity of soil for shallow foundation. *Journal of Applied Engineering Sciences*, *12*(1). https://doi.org/10.2478/jaes-2022-0005

Dempsey, N., Bramley, G., Power, S., & Brown, C. (2011a). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development*, *19*(5). https://doi.org/10.1002/sd.417

Dempsey, N., Bramley, G., Power, S., & Brown, C. (2011b). The social dimension of sustainable development: Defining urban social sustainability. *Sustainable Development*, *19*(5). https://doi.org/10.1002/sd.417

Dillenbourg, P. (2007). What do you mean by collaborative learning? What do you mean by "collaborative learning"? *Collaborative Learning: Cognitive and Computational Approaches*, *1*(March).

Dixit, A. M. (2004). Promoting safer building construction. *Proceedings of the 13th World Conference on Earthquake Engineering*, *1717*.

Dixit, M. A., Parajuli, K. Y., & Guragain, R. (2004). Indigenous skills and practices of earthquake resistant construction in Nepal. *13th World Conference on Earthquake Engineering*.

Djabarouti, J., & O'Flaherty, C. (2020). Architect and craftsperson: project perceptions, relationships and craft. *Archnet-IJAR: International Journal of Architectural Research*, *14*(3). https://doi.org/10.1108/ARCH-01-2020-0010

Ehler Pavel, & Shrestha Santosh. (2015). (PDF) A study to promote recycling of construction and demolition waste in the Kathmandu valley, Nepal. *Iwwg-Arb*, *April 2015*.

Eizenberg, E., & Jabareen, Y. (2017a). Social sustainability: A new conceptual framework. *Sustainability (Switzerland)*, *9*(1). https://doi.org/10.3390/su9010068

Eizenberg, E., & Jabareen, Y. (2017b). Social sustainability: A new conceptual framework. *Sustainability (Switzerland)*, *9*(1). https://doi.org/10.3390/su9010068

Erlandson, D. A. (1993). Doing naturalistic inquiry: A guide to methods (vital source edition).

Fien, J., & Winfree, T. (2014). Drivers of change in construction training: How significant is the sustainability agenda? *Prospects*, *44*(2). https://doi.org/10.1007/s11125-014-9304-3

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. In *Annual Review of Environment and Resources* (Vol. 30). https://doi.org/10.1146/annurev.energy.30.050504.144511

Forbes, C. (2018). Rebuilding Nepal: traditional and modern approaches, building or diminishing resilience? *International Journal of Disaster Resilience in the Built Environment*, *9*(3). https://doi.org/10.1108/IJDRBE-01-2017-0001

Frangedaki, E., Gao, X., Lagaros, N. D., Briseghella, B., Marano, G. C., Sargentis, G. F., & Meimaroglou, N. (2020). Fujian Tulou rammed earth structures: optimizing restoration techniques through participatory design and collective practices. *Procedia Manufacturing*, *44*. https://doi.org/10.1016/j.promfg.2020.02.209

Gautam, D., Prajapati, J., Paterno, K. V., Bhetwal, K. K., & Neupane, P. (2016). Disaster resilient vernacular housing technology in Nepal. *Geoenvironmental Disasters*, *3*(1). https://doi.org/10.1186/s40677-016-0036-y

Gautam, D., Rodrigues, H., Bhetwal, K. K., Neupane, P., & Sanada, Y. (2016). Common structural and construction deficiencies of Nepalese buildings. *Innovative Infrastructure Solutions*, *1*(1). https://doi.org/10.1007/s41062-016-0001-3

Ghasemi, F. (2017). Clean energy efficiency of vernacular-traditional architectural indicators for the development of sustainable tourism. *Journal of Sustainable Development*, *10*(3). https://doi.org/10.5539/jsd.v10n3p250

Ghisellini, P., Ripa, M., & Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. *Journal of Cleaner Production*, *178*. https://doi.org/10.1016/j.jclepro.2017.11.207

Goldschmidt, K., Harrison, T., Holtry, M., & Reeh, J. (2013). Sustainable procurement: Integrating classroom learning with university sustainability programs. *Decision Sciences Journal of Innovative Education*, *11*(3). https://doi.org/10.1111/dsji.12007

Government of Nepal. (2020). *Second nationally determined contribution (NDC) Nepal*. http://climate.mohp.gov.np/attachments/article/167/Second%20Nationally%20Determined%20Contribution%20(NDC)%20-%202020.pdf

Gray, J. (2011). Building a house in Nepal: Auspiciousness as a practice of emplacement. *Social Analysis*, *55*(1). https://doi.org/10.3167/sa.2011.550104

Grbich, C. (2022). Qualitative data analysis: An Introduction. In *Qualitative Data Analysis: An Introduction*. https://doi.org/10.4135/9781529799606

Gudynas, E. (2011). Buen vivir: Today's tomorrow. *Development*, *54*(4). https://doi.org/10.1057/dev.2011.86

Gustafsson, J. (2017). Single case studies vs. multiple case studies: A comparative study. *Academy of Business, Engineering and Science Halmstad University, Sweden*.

Gyawali, T. R. (2022). Re-use of concrete/brick debris emerged from big earthquake in recycled concrete with zero residues. *Cleaner Waste Systems*, *2*. https://doi.org/10.1016/j.clwas.2022.100007

Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability. *Sustainability (Switzerland)*, *15*(13). https://doi.org/10.3390/su151310682

Herczeg, G., Akkerman, R., & Hauschild, M. Z. (2018). Supply chain collaboration in industrial symbiosis networks. *Journal of Cleaner Production*, *171*. https://doi.org/10.1016/j.jclepro.2017.10.046

Heyns, A. M., & Banick, R. (2024). Optimisation of rural roads planning based on multi-modal travel: a multi-service accessibility study in Nepal's remote Karnali Province. *Transportation*, *51*(2). https://doi.org/10.1007/s11116-022-10343-3

Hubka, T. (1979). Just folks designing vernacular designers and the generation of form. *Journal of Architectural Education*, *32*(3). https://doi.org/10.1080/10464883.1979.10758609

Ingold, T., & Kurttila, T. (2000). Perceiving the environment in Finnish lapland. *Body & Society*, *6*(3–4). https://doi.org/10.1177/1357034X00006003010

Jabareen, Y. (2012). Towards a sustainability education framework: Challenges, concepts and strategies-the contribution from urban planning perspectives. *Sustainability*, *4*(9). https://doi.org/10.3390/su4092247

Jensen, O., & Ong, C. (2020). Collaborative action for community resilience to climate risks: Opportunities and barriers. *Sustainability (Switzerland)*, *12*(8). https://doi.org/10.3390/SU12083413

Kabeer, N. (2005). Gender equality and women's empowerment: A critical analysis of the third Millennium Development Goal. *Gender and Development*, *13*(1). https://doi.org/10.1080/13552070512331332273

Khalili, N. R. (2011). Practical sustainability: From grounded theory to emerging strategies. In *Practical Sustainability: From Grounded Theory to Emerging Strategies*. https://doi.org/10.1057/9780230116368

Khoshnava, S. M., Rostami, R., Zin, R. M., Štreimikienė, D., Mardani, A., & Ismail, M. (2020). The role of green building materials in reducing environmental and human health impacts. *International Journal of Environmental Research and Public Health*, *17*(7). https://doi.org/10.3390/ijerph17072589

Kibert, C. J. (2007). The next generation of sustainable construction. In *Building Research and Information* (Vol. 35, Issue 6). https://doi.org/10.1080/09613210701467040

Kioupi, V., & Voulvoulis, N. (2019). Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability (Switzerland)*, *11*(21). https://doi.org/10.3390/su11216104

Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly: Management Information Systems*, *23*(1). https://doi.org/10.2307/249410

Kong, X., Fu, M., Zhao, X., Wang, J., & Jiang, P. (2022). Ecological effects of land-use change on two sides of the Hu Huanyong Line in China. *Land Use Policy*, *113*. https://doi.org/10.1016/j.landusepol.2021.105895

Lekshmi, M. S., Vishnudas, S., & Nair, D. G. (2020). Strength, sorptivity and shrinkage characteristics of cow dung stabilized mud mortar. *Materials Today: Proceedings*, *32*. https://doi.org/10.1016/j.matpr.2020.03.715

Liauw, F. (2019). Reference for contextual design. *IOP Conference Series: Materials Science and Engineering*, *508*(1). https://doi.org/10.1088/1757-899X/508/1/012031

Lingard, H., Graham, P., & Smithers, G. (2000). Employee perceptions of the solid waste management system operating in a large Australian contracting organization: Implications for company policy implementation. *Construction Management and Economics*, *18*(4). https://doi.org/10.1080/01446190050024806

Liuzzi, S., Hall, M. R., Stefanizzi, P., & Casey, S. P. (2013). Hygrothermal behaviour and relative humidity buffering of unfired and hydrated lime-stabilised clay composites in a Mediterranean climate. *Building and Environment*, *61*. https://doi.org/10.1016/j.buildenv.2012.12.006

Lokot, M. (2021). Whose voices? Whose knowledge? A feminist analysis of the value of key informant interviews. *International Journal of Qualitative Methods,20*. https://doi.org/10.1177/1609406920948775

Lührmann, A., & Rooney, B. (2021). Autocratization by decree: States of emergency and democratic decline. *Comparative Politics*, *53*(4). https://doi.org/10.5129/001041521X16004520146485

Madikizela, K., & Haupt, T. (2010). Influences on women's choices of careers in construction: A South African study. *Construction Economics and Building*, *10*(1–2). https://doi.org/10.5130/ajceb.v10i1-2.1582

Makondo, C. C., & Thomas, D. S. G. (2018). Climate change adaptation: Linking indigenous knowledge with western science for effective adaptation. *Environmental Science and Policy*, *88*. https://doi.org/10.1016/j.envsci.2018.06.014

Manavazhi, M. R., & Adhikari, D. K. (2002). Material and equipment procurement delays in highway projects in Nepal. *International Journal of Project Management*, *20*(8). https://doi.org/10.1016/S0263-7863(02)00027-3

Maqbool, R., Namaghi, J. R., Rashid, Y., & Altuwaim, A. (2023). How modern methods of construction would support to meet the sustainable construction 2025 targets, the answer is still unclear. *Ain Shams Engineering Journal*, *14*(4). https://doi.org/10.1016/j.asej.2022.101943

Martínez Quintana, V. (2021). Eco-cultural tourism: Sustainable development and promotion of natural and cultural heritage. In *Tourism*. https://doi.org/10.5772/intechopen.93897

Martín, S., Mazarrón, F. R., & Cañas, I. (2010). Study of thermal environment inside rural houses of Navapalos (Spain): The advantages of reuse buildings of high thermal inertia. *Construction and Building Materials*, *24*(5). https://doi.org/10.1016/j.conbuildmat.2009.11.002

Mavi, R. K., Gengatharen, D., Mavi, N. K., Hughes, R., Campbell, A., & Yates, R. (2021). Sustainability in construction projects: A systematic literature review. In

Sustainability (Switzerland) (Vol. 13, Issue 4). https://doi.org/10.3390/su13041932

McKenna, S. A., Iwasaki, P. G., Stewart, T., & Main, D. S. (2011). Key informants and community members in community-based participatory research: one is not like the other. *Progress in Community Health Partnerships : Research, Education, and Action*, *5*(4). https://pubmed.ncbi.nlm.nih.gov/22616206/

Memon, M. A. (2015). Disaster waste recovery and utilization in developing countries-Learning from earthquakes in Nepal. *15th Asian Regional Conference on Soil Mechanics and Geotechnical Engineering, ARC 2015: New Innovations and Sustainability*. https://doi.org/10.3208/jgssp.ESD-KL-7

Minke, G. (2021). Building with Earth. In *Building with Earth*. https://doi.org/10.1515/9783035622553

Minunno, R., O'Grady, T., Morrison, G. M., & Gruner, R. L. (2021). Investigating the embodied energy and carbon of buildings: A systematic literature review and meta-analysis of life cycle assessments. In *Renewable and Sustainable Energy Reviews* (Vol. 143). https://doi.org/10.1016/j.rser.2021.110935

Morel, J. C., Mesbah, A., Oggero, M., & Walker, P. (2001). Building houses with local materials: Means to drastically reduce the environmental impact of construction. *Building and Environment*, *36*(10). https://doi.org/10.1016/S0360-1323(00)00054-8

Mpofu, D., & Miruka, C. (2009). Indigenous knowledge management transfer systems across generations In Zimbabwe. *Indilinga: African Journal of Indigenous Knowledge Systems*, *8*(1). https://doi.org/10.4314/indilinga.v8i1.48247

Muyen, Z., Barna, T., & Hoque, M. (2016). Strength properties of plastic bottle bricks and their suitability as construction materials in Bangladesh. *Progressive Agriculture*, *27*(3). https://doi.org/10.3329/pa.v27i3.30833

Nasr, Y., El Zakhem, H., Hamami, A. E. A., El Bachawati, M., & Belarbi, R. (2023). comprehensive review of innovative materials for sustainable buildings' energy performance. *Energies*,16(21). https://doi.org/10.3390/en16217440

Nguyen, A. T., & Reiter, S. (2017). Bioclimatism in architecture: An evolutionary perspective. *International Journal of Design and Nature and Ecodynamics*,*12*(1). https://doi.org/10.2495/DNE-V12-N1-16-29

Nguyen, C. V., & Tarp, F. (2022). Changing male perceptions of gender equality: Evidence from a randomised controlled trial study. *World Development*, *158*. https://doi.org/10.1016/j.worlddev.2022.106019

Nyong, A., Adesina, F., & Osman Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global Change*, *12*(5). https://doi.org/10.1007/s11027-007-9099-0

Oladiran, O. J. (2015). Investigating the use of local materials for building construction. *Journal of Sustainable Technology*, *6*(2).

Omer, A. M. (2008). Energy, environment and sustainable development. In *Renewable and Sustainable Energy Reviews* (Vol. 12, Issue 9). https://doi.org/10.1016/j.rser.2007.05.001

Pacheco-Torgal, F., & Jalali, S. (2012). Earth construction: Lessons from the past for future eco-efficient construction. In *Construction and Building Materials* (Vol. 29). https://doi.org/10.1016/j.conbuildmat.2011.10.054

Papadaki, D., Nikolaou, D. A., & Assimakopoulos, M. N. (2022). Circular environmental impact of recycled building materials and residential renewable energy. *Sustainability (Switzerland)*, *14*(7). https://doi.org/10.3390/su14074039

Parajuli, B. K. (2012). Knowledge and practice of traditional skill technology among hill Dalit of Kaski (A study based on Pariyars, Nepali and Bishowkarma of Kaski District). *Himalayan Journal of Sociology and Anthropology*, *5*. https://doi.org/10.3126/hjsa.v5i0.7037

Pérez-Lombard, L., Ortiz, J., & Pout, C. (2008). A review on buildings energy consumption information. *Energy and Buildings*, *40*(3). https://doi.org/10.1016/j.enbuild.2007.03.007

Pešić, N., Živanović, S., Garcia, R., & Papastergiou, P. (2016). Mechanical properties of concrete reinforced with recycled HDPE plastic fibres. *Construction and Building Materials*, *115*. https://doi.org/10.1016/j.conbuildmat.2016.04.050

Piwowar-Sulej, K. (2021). Human resources development as an element of sustainable HRM – with the focus on production engineers. *Journal of Cleaner Production*, *278*. https://doi.org/10.1016/j.jclepro.2020.124008

Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy*, *6*(1). https://doi.org/10.1353/jod.1995.0002

Radzuan, I. S. M., Mansir, D., & Ahmad, Y. (2017). Exploring training factors as incentive tools in safeguarding cultural heritage of Malaysian traditional settlements. *Journal of Heritage Management*, *2*(2). https://doi.org/10.1177/2455929617743585

Robinson, J. B., & Herbert, D. (2001). Integrating climate change and sustainable development. *International Journal of Global Environmental Issues*, *1*(2). https://doi.org/10.1504/IJGENVI.2001.000974

Romão, X., Paupério, E., & Menon, A. (2015). Traditional construction in high seismic zones: A losing battle? the case of the 2015 Nepal earthquake. *Seismic Retrofitting: Learning from Vernacular Architecture*. https://doi.org/10.1201/b18856

Royer, M. (2022). What participation creates in experimental design practices. The case of a mobile third place built in a retirement home. *Architecture*, *2*(1). https://doi.org/10.3390/architecture2010004

Sabatini, F. (2019). Culture as fourth pillar of sustainable development: Perspectives for integration, paradigms of action. *European Journal of Sustainable Development*, *8*(3). https://doi.org/10.14207/ejsd.2019.v8n3p31

Salah, M., Elmasry, M., Mashhour, I. M., & Amer, N. (2023). A framework for assessing sustainability of construction projects. *Cleaner Engineering and Technology*, *13*. https://doi.org/10.1016/j.clet.2023.100626

Saldaña, J. (2016). The Coding Manual for Qualitative Researchers (No. 14). *Sage*.

Sciences, A. (2017). Nepalese journal of agricultural. *Nepalese Journal of Agricultural Sciences*, *15*(September).

Shrestha, B. K., & Shrestha, S. (2009). Transformation of traditional building stocks in the historic core of Kathmandu : looking through the prism of culture and climate. *Protibesh:Environment, Jornal of the Department of Architecture*, *13*(1).

Shrestha, S., & Singh, S. (2019). Exploring the potential of eco-village for sustainable development: a case at Lele. *Proceedings of IOE Graduate Conference*.

Sizirici, B., Fseha, Y., Cho, C. S., Yildiz, I., & Byon, Y. J. (2021). A review of carbon footprint reduction in construction industry, from design to operation. In *Materials* (Vol. 14, Issue 20). https://doi.org/10.3390/ma14206094

Skowronski, M., & Charytonowicz, J. (2010). Building with reclaimed materials in view of ergonomic design. In *Advances in Occupational, Social, and Organizational Ergonomics*. https://doi.org/10.1201/EBK1439835074

Slevitch, L. (2011a). Qualitative and quantitative methodologies compared: Ontological and epistemological perspectives. *Journal of Quality Assurance in Hospitality and Tourism*, *12*(1). https://doi.org/10.1080/1528008X.2011.541810

Slevitch, L. (2011b). Qualitative and quantitative methodologies compared: Ontological and epistemological perspectives. *Journal of Quality Assurance in Hospitality and Tourism*, *12*(1). https://doi.org/10.1080/1528008X.2011.541810

Sol, K., & Heng, K. (2022). Understanding epistemology and its key approaches in research. *Cambodian Journal of Educational Research*, *2*(2). https://doi.org/10.62037/cjer.2022.02.02.05

Spišáková, M., & Mačková, D. (2015). The use potential of traditional building materials for the realization of structures by modern methods of construction. Selected scientific papers. *Journal of Civil Engineering*, *10*(2). https://doi.org/10.2478/sspjce-2015-0024

Starck, T., Fardet, T., & Esculier, F. (2024). Fate of nitrogen in French human excreta: Current waste and agronomic opportunities for the future. *Science of the Total Environment*, *912*. https://doi.org/10.1016/j.scitotenv.2023.168978

Swart, R., Robinson, J., & Cohen, S. (2003). Climate change and sustainable development: Expanding the options. *Climate Policy*, *3*(SUPPL 1). https://doi.org/10.1016/j.clipol.2003.10.010

Thormark, C. (2006). The effect of material choice on the total energy need and recycling potential of a building. *Building and Environment*, *41*(8). https://doi.org/10.1016/j.buildenv.2005.04.026

Thornton, P. K., & Herrero, M. (2015). Adapting to climate change in the mixed crop and livestock farming systems in sub-Saharan Africa. *Nature Climate Change*,5(9). https://doi.org/10.1038/nclimate2754

Throsby, D. (2017). Culturally sustainable development: theoretical concept or practical policy instrument? *International Journal of Cultural Policy*, *23*(2). https://doi.org/10.1080/10286632.2017.1280788

Tracy, S. J. (2010). Qualitative quality: Eight a"big-tent" criteria for excellent qualitative research. *Qualitative Inquiry*, *16*(10). https://doi.org/10.1177/1077800410383121

Turan, K. (2015). Green materials and applications. *Periodicals of Engineering and Natural Sciences (PEN)*, *3*(2). https://doi.org/10.21533/pen.v3i2.59

Turner, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *Qualitative Report*, *15*(3). https://doi.org/10.46743/2160-3715/2010.1178

Usman, K., Khan, S., Ghulam, S., Khan, M. U., Khan, N., Khan, M. A., & Khalil, S. K. (2012). Sewage sludge: An important biological resource for sustainable agriculture and its environmental implications. *American Journal of Plant Sciences*, *03*(12). https://doi.org/10.4236/ajps.2012.312209

Vázquez-Barquero, A., & Rodríguez-Cohard, J. C. (2019). Local development in a global world: Challenges and opportunities. *Regional Science Policy and Practice*, *11*(6). https://doi.org/10.1111/rsp3.12164

Volkov, A. A., & Tuskaeva, Z. R. (2017). Ergonomic and ecological safety factors necessary to improve the competitiveness of the domestic construction machinery. *Vestnik MGSU*, *3*. https://doi.org/10.22227/1997-0935.2017.3.308-316

Wang, C., Cardon, P. W., Liu, J., & Madni, G. R. (2020). Social and economic factors responsible for environmental performance: A global analysis. *PLoS ONE*, *15*(8 April). https://doi.org/10.1371/journal.pone.0237597

William Dobson, D., Sourani, A., Sertyesilisik, B., & Tunstall, A. (2013). Sustainable construction: Analysis of its costs and benefits. *American Journal of Civil Engineering and Architecture*, *1*(2). https://doi.org/10.12691/ajcea-1-2-2

Woolley, T. (2007). Natural building: A guide to materials and techniques. *Management of Environmental Quality: An International Journal*, *18*(1). https://doi.org/10.1108/meq.2007.08318aae.001

Wong, C. L., Mo, K. H., Yap, S. P., Alengaram, U. J., & Ling, T. C. (2018). Potential use of brick waste as alternate concrete-making materials: A review. In *Journal of Cleaner Production* (Vol. 195). https://doi.org/10.1016/j.jclepro.2018.05.193

Xu, L., Li, J., & Zhou, X. (2019). Exploring new knowledge through research collaboration: the moderation of the global and local cohesion of knowledge networks. *Journal of Technology Transfer*, *44*(3). https://doi.org/10.1007/s10961-017-9614-8

Yin, R. K. (2012). *A (very) brief refresher on the case study method. The. Applications of Case Study Research*.

Zabihi, H., Habib, F., & Mirsaeedie, L. (2012). Sustainability in building and construction : Revising definitions and concepts. *International Journal of Emerging Sciences*, *2*(December).

Zamiri, M., & Esmaeili, A. (2024). Methods and technologies for supporting knowledge sharing within learning communities: A systematic literature review. In *Administrative Sciences*,*14*(1). https://doi.org/10.3390/admsci14010017

Zen, A. C., Lima, A., Bianchi, A. L., & Babot, L. (2012). Sustainability, energy and development: A proposal of indicators. *International Journal for Infonomics*, *5*(1/2). https://doi.org/10.20533/iji.1742.4712.2012.0060

Zhang, X., & Zhang, Z. (2020). How do smart villages become a way to achieve sustainable development in rural areas? Smart village planning and practices in China. *Sustainability (Switzerland)*, *12*(24). https://doi.org/10.3390/su122410510

Zhao, X., Zuo, J., Wu, G., & Huang, C. (2019). A bibliometric review of green building research 2000–2016. In *Architectural Science Review* (Vol. 62, Issue 1). https://doi.org/10.1080/00038628.2018.1485548

Zhu, P., Shen, Y., Pan, X., Dong, B., Zhou, J., Zhang, W., & Li, X. (2021). Reducing odor emissions from feces aerobic composting: Additives. In *RSC Advances* (Vol. 11, Issue 26). https://doi.org/10.1039/d1ra00355k

Appendices

Appendix A

The table is prepared by the researcher based on the literature found.

Table 2

Laws, Acts, and Regulations of the Building Construction in Nepal

Document Types	**Titles**
	• Solid Waste Management Act 2017 • Disaster Risk Reduction Management Act 2017 • The Environment Protection Act 1997 • The Environment Protection Act 2019
Strategic Planning	• Disaster Risk Reduction National Strategic Plan of Action 2018-2030 • National Urban Development Strategy 2017 • National Adaptation Program of Action • National Climate Change
Guideline	• National Disaster Response Team • Local Disaster Risk Management Planning Guideline • Earthquake Resistant Building Construction: Low Strength Masonry • Earthquake Resistant Building Construction: Earthen Building
Policy	• National Shelter Policy 1996 • Land Use Policy 2015 • National Climate Change Policy 2019
Framework	• Post Disaster Recovery Framework 2016- 2020

Table 3

Key Features of building construction related legislations of Nepal

List of Laws, Act and Regulations	Endorsed Year	Key features
Nepal National Building Code NBC 206- 2055	1998	• Initiates provision of environmentally friendly buildings, • Encourages adaptation and mitigation strategies in planning
National Adaptation Program of Action (NAPA)	2008-2010	• Includes measures for sustainable building practices to adapt to climate change impacts
Solid Waste Management Act -2011	2011	• Regulate the final disposal of solid waste • Promote recycling and processing and privatize management works in phases • Section 10: Local governments may issue instructions for efficient execution to promote the reduction, reuse, and reutilizing of solid waste. • Sections 12 and 16: Allow private sector to construct and run recycling center and landfills while following to environmental regulations and other applicable legislation. • Section 14: Partnership with the private, community and non-governmental organization for reduction, collection and recycling

		of solid waste management. • Section 15: Competitive bidding to award solid waste management contracts to the public or private sectors based on standards such technological capability and environmental sustainability.
Land Use Policy 2015	2015	Criteria 1: The development of land use plans has been referenced in policy as a means of ensuring a hygienic, attractive, well-facilitated, and secure human settlement, as well as a sustainable and planned urbanization of the nation. Criteria 2: Identification of land use zones is now a part of policy. The designation of the Excavation Zone for Building Materials (Stone, Sand, and Concrete), among other zones, has been approved under this policy. Criteria 3: The land has been divided into various land use zones. Sensitive zone identification has been incorporated into policy to maintain a balance between environmental protection and development in order to reduce both natural and man-made dangers.
Post Disaster Recovery Framework (PDRF) 2016-2020	May 2016	Policy Objectives for Recovery and Reconstruction • By using the local technologies as needed reconstructing, retrofitting and restoring partially and completely damaged buildings. • Improving the resilience of the structures by restoring the

		damaging cities and villages. Approaches for Housing Reconstruction: • Rebuilding homes that are resistant to disasters while emphasizing environmental friendliness and sustainable practices. • Support for rebuilding on-site, unless relocation is required. Place a strong emphasis on assisting and teaching homeowners to oversee their rehabilitation projects.
National Urban Development Strategy 2017	2017	Includes sustainable building techniques to manage urban development and reduce environmental impact Solid Waste Collection • Promote join effort with public private in waste collection and management • Incorporate sanitary landfill site as transitional strategy to reach condition of 3R (Reuse, Reduce, Recycle) • Incentivize private sector to reuse and recycle waste by suitable technology Housing • Promote innovative, economic, and environment friendly buildings • Encourage the use of materials which are energy efficient and passive design. Urban strategy and Resilience • Encourage in dealing with disaster

		including climate change through multi hazards approach: a. incorporates disaster risk management component in urban development plans Build back better after any disaster • Offer technical assistance at household level for safer building practices • Monitor structure and functional changes in the buildings. Develop capacity building tools and training programs Improve the human resource and institutional capabilities of the government and local bodies.
Environment Protection Act (2019)	2019	Section 23: Periodic Studies and Information Dissemination • Conduct studies on the negative effects of climate change on local communities, eco systems, and biodiversity. Section 24: Adaptation Plans • To avoid the negative consequences and hazards of climate change, the Ministry, Provincial Ministry, and Local Level may develop and implement an adaptation strategy at the National, Provincial, and Local levels, respectively. Section 27: Technical Standards • Determine and implement standards for urban and rural areas

		to reduce the negative effects and hazards of climate change. • Develop necessary policy and technical standards for technology development in relevant areas.
Disaster Risk Reduction National Strategic Plan of Action - 2018-2030	2018	• Encourages "Build Back Better," a sustainable and environmentally friendly approach to resource use in reconstruction that includes building that is resistant to disasters. • Developing policies and educational initiatives to encourage the application of both contemporary and conventional building construction methods for improved catastrophe risk reduction. • Encourage the study and advancement of infrastructure design, construction technology, materials, and management for "Build Back Better" disaster risk reduction, reconstruction, and climate change adaptation. • Increase the ability of engineers, builders, carpenters, masons, contractors, and suppliers by implementing a program of training and awareness-raising for more resilient and superior reconstruction after a disaster. Create and make use of local labor,

		technology, resources, and expertise in reconstruction and rehabilitation.
National Climate Change Policy 2076 (2019)	2019	Policy: In order to construct climate-friendly towns and cities, safe, resilient and sustainable ecosystems and infrastructure will be created.
National Climate Change Policy 2076 (2019)	2019	Strategies and Working Policies: •Adaptation programs will be conducted to mitigate the adverse consequences of climate change on communities and households residing in both urban and rural areas, as well as locations exposed to climate change related hazards. • Plans for settlement development will include provisions for low-emission technologies and adaption initiatives. • To ensure that rural and urban areas are included in settlement development plans, standards will be created and put into practice. Tourism and Natural and Cultural Heritage • The tourism industry will integrate concepts related to climate-friendly tourism, such as eco-tourism, green trekking routes, and diversification. • Identify and protect sensitive natural and cultural heritage areas from the negative effects of climate change. • The community and private sector will be urged to participate in the

	development of climate-friendly tourism initiatives. Disaster Risk Reduction and Management • In order to build resilient societies, standards will be developed to foster a culture of safety in the event of a disaster. Technology: • By undertaking a need evaluation of technologies relevant to climate change adaptation and mitigation, an action plan for technology development will be developed and implemented. • The development and utilization of climate-friendly traditional and nature-based technologies will be encouraged.

Appendix B

Questionnaire

Form of Participation

a. Participation to supply the processual character of production: the permanence

1. How did the residency approach, as seen in construction workshops, democratize the involvement of architects in experimental practices?
2. What role did various stakeholders such as students, neighbors, associations, and elected officials play in the participatory construction process?
3. How did the participatory construction site become a meeting point for experimentation, exchange, and collaboration?
4. In what ways did living within the context contribute to understanding its specificities and evolving the design project accordingly?
5. What were some challenges faced during the participatory design process, and how were they overcome?
6. How did the involvement of diverse participants enrich the design and construction process?

7. What were the key benefits of involving people directly in the construction process?
8. How did the participatory approach impact the long-term sustainability and functionality of the constructed space?
9. Can you share any specific examples of how the design evolved based on the input and experiences of participants?
10. How did the participatory approach contribute to fostering a sense of ownership and community among stakeholders?

b. Participation in order to collectively shape the work: The prototype, the Self Construction

1. How did the prototype process bring life to the experimentation of the project?
2. What were the main differences between conventional design processes and the collaborative approach used in self-construction projects?
3. How did conducting design and construction activities simultaneously on site impact the project's outcome?
4. Can you elaborate on how workshops were utilized to decompartmentalize skills and promote collective design?
5. What were some innovative ways in which local people's skills were improved during the prototype process?
6. How were recycled materials and former medical devices creatively repurposed in the construction process?
7. What role did hands-on training and skill-sharing play in empowering participants to contribute to the project?
8. How did the self-construction approach align with the principles of sustainability and resourcefulness?
9. Can you discuss any challenges encountered in implementing the self-construction model and how they were addressed?
10. In what ways did the participatory approach foster a sense of ownership and pride among participants?
11. What kind of construction of workshops were provided to work skills ? Is that work helpful for the improvement of people?

c. Participation to build durable events: ephemeral artifacts

1. How was the experimental nature of the participatory construction site embraced by practitioners?

2. What were the key differences between producing architectural/design projects and building ephemeral artifacts for events?
3. How did the participatory construction process contribute to raising awareness among residents about their living environment?
4. Can you discuss the role of trial and error methods during construction events?
5. How did the choice of perishable materials and specific construction techniques align with the project's goals?
6. What were some examples of ephemeral architecture created during the participatory construction process?
7. How did the construction of ephemeral artifacts serve as a catalyst for community engagement and interaction?
8. Can you share any insights into how the participatory approach influenced the design and construction of ephemeral structures?
9. What were some of the challenges faced in balancing the temporary nature of ephemeral artifacts with their functional and aesthetic requirements?
10. How did the participatory construction process contribute to the overall success and impact of the events hosted in these ephemeral structures?

d. Supply of construction materials and involvement of traditional artisan (Joshi et al., 2021)

1. What kind of participation was there between the local artisan and the architect?
2. How positive was this collaboration?
3. How did it help the people to have construction on site?
4. What kind of exchange of knowledge helped in the improvement or the betterness of the project?
5. Was it difficult to understand what the other was practicing?
6. Where did you feel heard on site? How involved were you in the decision-making of the construction?
7. Who supplied the construction site materials?
8. How easy was it when there was involvement of the community people on site?
9. Did the donation from the foreign country lead to less public participation and detach from the product?
10. What were the challenges during this exchange of knowledge?

Sustainability

Traditional Knowledge:

1. Can you provide examples of specific natural materials commonly used in indigenous building practices in your community?
2. How do indigenous building techniques incorporate principles of environmental sustainability and resource conservation?
3. Are there any rituals or ceremonies associated with traditional building practices in your culture?
4. What role do cultural beliefs and values play in shaping indigenous approaches to architecture and construction?
5. How has the knowledge of traditional building techniques been passed down through generations within your community?
6. Are there any specific challenges or limitations associated with using indigenous building methods in modern construction projects?
7. Can you share some success stories or examples of indigenous-led building projects that have positively impacted your community?
8. How do indigenous building techniques contribute to the resilience of structures against natural disasters or harsh environmental conditions?
9. Are there any efforts underway to document and preserve indigenous building knowledge for future generations?
10. How do indigenous building practices reflect the unique cultural identity of your community?
11. Has there been any collaboration or knowledge exchange between indigenous builders and modern architects/engineers?
12. How do indigenous building techniques address issues of energy efficiency and thermal comfort?
13. Are there any taboos or cultural considerations that influence the design and construction of buildings in your community?
14. In what ways do indigenous building methods promote social cohesion and community participation?
15. How do you see the role of indigenous architecture evolving in the context of contemporary sustainable development initiatives?

Assistantship

1. What role does assistantship play in passing down knowledge and skills related to natural and recycled building construction in your community?
2. How are workers typically selected and trained in these practices?

3. What are the main benefits of these construction in this field, both for the local workers themselves and for the community at large?
4. How do you ensure that workers maintain a balance between traditional methods and modern innovations?
5. What are the typical pathways for individuals in your community to learn about natural and recycled building techniques?
6. Can you describe the role of workers/villagers in passing down knowledge and skills in construction?
7. How do you select apprentices or trainees for your projects?
8. What specific skills or qualities do you look for in potential workers/architects?
9. How do you structure your apprenticeship programs to ensure comprehensive learning experiences?
10. Are there any formal training programs or institutions that focus on natural and recycled building practices in your region?
11. How do you balance traditional methods of learning with formal education in your training programs?
12. What are the main challenges faced by aspiring builders during their training or apprenticeship?
13. How do you assess the proficiency of apprentices before they are considered fully trained?
14. What support systems are in place for apprentices as they progress through their training?
15. How do you incorporate hands-on experience into the training curriculum?
16. Are there opportunities for ongoing professional development or specialization within natural and recycled building practices?
17. How do you ensure that the knowledge and skills passed down through apprenticeship remain relevant in a rapidly changing construction landscape?
18. Do you engage in knowledge exchange or training initiatives with architects or builders from other regions or countries?
19. What advice would you give to individuals who are interested in pursuing a career in natural and recycled building construction but lack formal training opportunities in their area?

Training:

1. What types of formal or informal training opportunities exist for individuals interested in learning about natural and recycled building techniques?
2. What are the intentions of making the people of Dhoksan work, and what goals or benefits do you hope to provide them?
4. How accessible are these training programs to members of the community, including marginalized groups or those with limited resources?
5. Are any specific skills or knowledge areas particularly emphasized in training programs for natural and recycled building construction?
6. How do you see the demand for training in these techniques evolving in the future, considering increasing awareness of sustainability and environmental concerns?
7. What is your intention when you make such a training program?

Integration of Modern Methods:

1. In what ways do traditional building techniques complement or conflict with modern construction practices?
2. How do you navigate the integration of modern materials and technologies into traditional building methods while maintaining sustainability?
3. Are there any challenges or barriers to adopting modern methods within the context of natural and recycled building construction?

Community Engagement:

1. How do you involve the community in natural and recycled building projects, from planning to implementation?
2. What strategies do you use to raise awareness and promote participation in sustainable building practices within the community?
3. How do you address any concerns or resistance within the community regarding the adoption of alternative building techniques?