INTERNATIONAL JOURNAL OF SUSTAINABLE RURAL DEVELOPMENT

GLOBAL FORUM FOR SUSTAINABLE RURAL DEVELOPMENT

Volume 1 Issue 1 (2024)

PUBLISHED BY: E-PALLI PUBLISHERS, DELAWARE, USA

Global Forum for
Sustainable Rural Development

**International Journal of
Sustainable Rural Development (IJSRD)**

Volume 1 Issue 1, Year 2024
https://journals.e-palli.com/home/index.php/ijsrd

The Tendency of Eco-Brick Uses in Bangladesh: Current Trends and Future Needs

Md. Abu Shehen[1*]

Article Information

Received: April 19, 2024
Accepted: May 29, 2024
Published: August 01, 2024

Keywords
Brick, Construction, Environment, Microentrepreneurs

ABSTRACT

This study examined the inclination of microentrepreneurs (MEs) to utilize and engage in commerce with environmentally friendly construction materials as opposed to conventional bricks. The propensity was explored using focus group discussions and key informant interviews. The research region underwent a total of eight Key Informant Interviews (KIIs) and four Focus Group Discussions (FGDs). Nevertheless, the survey revealed that a small number of microentrepreneurs have a fundamental understanding of the environment and pollution. A significant proportion of the MEs failed to implement waste management effectively. The study also discovered that a minuscule proportion of MEs engage in ecologically sustainable production and advertising strategies. All brick kilns utilized topsoil as the primary material for manufacturing conventional fired bricks, employing firewood as the fuel source. They lacked sufficient expertise in utilizing fly ash as a component in the production of bricks and other construction materials. Furthermore, the level of women's involvement in these firms was exceedingly minimal, and they receive comparably meager remuneration from those enterprises. Enterprises should prioritize creating a supportive environment for women and implementing fair wage policies that result in improved compensation for female employees. A significant proportion of the microentrepreneurs (MEs) lacked training and failed to adhere to adequate safety protocols. Consequently, it is imperative to prioritize training programs focused on safety and security for both workers and microentrepreneurs.

INTRODUCTION

Within the construction business, "green" or sustainable construction is a relatively young and rapidly expanding field of study. Global projects, whether in Bangladesh or elsewhere, signal the start of a new era in which designing for sustainability may become the primary objective in the built environment. The building industry is striving to lessen its detrimental effects on the environment because it understands the need to be more ecologically conscientious. The energy crisis of the 1970s gave rise to the current greening of the construction industry. There has been a major push towards energy efficiency, conservation, and alternative energy sources as a result of these terrible experiences. The more water-conscious design was developed in response to the second wave of local water shortage issues in recent times. Groundwater contamination, sick building syndrome, and indoor air quality have forced us to reconsider the usage of landscaping chemicals and remove toxics from our interior spaces.

In building, materials such as cement, sand, aggregate, wood, steel, and water are employed. This construction material is created or comes straight from the natural world. Fifty percent of the world's material and energy are consumed by the construction industry, along with fifty percent of the non-fuel wood worldwide. A third of the freshwater resources are used during building (Roodman and Lenssen, 1995). Because of the atmospheric emission of greenhouse gases, mostly carbon dioxide, one of the biggest concerns of the twenty-first century has been viewed as being climate change. For instance, India emits 0.90 tonnes of carbon dioxide per tonne of cement produced, which is bad for the environment. According to the National Institute of Building Sciences in the United States, buildings generate greenhouse gases that makeup 35% of carbon dioxide, 49% of sulfur dioxide, and 25% of nitrogen oxide in the atmosphere (Statista, 2023). Overexploitation is reducing the availability of natural resources, and prices are growing steadily. Reducing CO2 emissions and dependency on natural resources can be achieved through the use of non-toxic and unconventional materials. This publication aims to consolidate research on smart and green materials while taking affordability, usability, and availability into account (Singh *et al.,* 2017). Nonetheless, this paper's primary goal is to learn about the present business model used in the research area's brick production industry for both conventional burned brick and eco-friendly brick.

Micro-Entrepreneurship

A universally accepted definition of a microenterprise does not exist. Microenterprises are small firms run by a family, a single self-employed person, or a very small number of employees (less than five) (Terry, 1999). Microbusinesses are "loosely defined as those with no employees or fewer than five employees," according to Jayachandran (2021). He called the owners of these industries' micro-entrepreneurs and these companies microenterprises. The ADB's Microenterprise Development Project defines microenterprises as commercial entities that

[1] University of Rajshahi, Rajshahi, Bangladesh
[*] Corresponding author's e-mail: oolalekan@edu.hse.ru

invest between Tk 40,000 and Tk 1.5 million, excluding the land and structures that are used for the enterprise. Microenterprises are defined by the Bangladesh Bureau of Statistics as companies with 10–24 people or fewer, or fixed assets worth between Tk 0.5 million and Tk 5 million, excluding land and buildings (ADB, 2018). Businesses that employ one to five persons full-time are referred to as micro-enterprises (Business Finance for the Poor in Bangladesh, 2017). Micro-entrepreneurship in this survey refers to entrepreneurship that is classified as an informal sector business and that typically has the following characteristics: it is easy to enter the market, it is family-owned and controlled, it operates on a small scale, it relies on local resources, it emphasises labor-intensive but low-level technology, and it develops skills outside of the classroom in an unregulated competitive market structure (Alam *et al.,* 2010).

Sustainable Construction

The concept of sustainable construction varies slightly depending on the field or even the region, but the basic idea remains the same: building with an emphasis on environmental responsibility. This covers not only how a structure is designed, constructed, run, maintained, and ultimately restored or demolished, but also how it is planned, built, run, maintained, and ultimately refurbished or destroyed. "Products or services that have a smaller or reduced effect on human health and the environment when compared to competitive products or services that fulfil the same purpose," according to the Environmental Protection Agency's (EPA) EPP programme. Because there are so few completely eco-friendly materials, it is imperative that both the first—that it do the least amount of environmental harm possible—and the second—that it be on a comparative basis (The Constructor, 2021). The core idea behind sustainability is to concentrate on cutting-edge projects and technologies that can be utilised endlessly without damaging the environment and guarantee a respectable standard of living for future generations, whether it be sustainable materials or renewable energy.

Eco-Friendly Construction Materials

Environmentally friendly building materials are easily recyclable and don't hurt the environment during production, use, or disposal. In the long run, using environmentally friendly products is really advantageous. Constructing a green home lowers energy consumption and carbon emissions considerably, saving energy expenses. As more and more people realise how crucial it is to create a more sustainable environment, eco-friendly construction materials are becoming more and more important. One excellent method to reduce any potential harm that building a home may have to the environment is to use eco-friendly construction materials. Additionally, due to the many advantages they provide, houses built using sustainable building materials are becoming more and more popular. Because they usually keep a house more insulated, sustainable building materials reduce the need for heating and air conditioning systems, which in turn uses less energy, gas and oil. This results in financial savings for homeowners. The following list of eco-friendly building materials can be used into a custom home design.

Social Aspects of Sustainable Construction

The application of sustainable development principles to the building life cycle, encompassing waste management, raw material extraction, and building material manufacture, is known as sustainable construction (Khan *et al.,* 2009; Yilmaz and Bakis, 2015). By creating suitable human settlements, advancing economic equality, and improving the quality of human existence, it is a comprehensive process meant to preserve the balance between nature and the construction site environment (Omardin *et al.,* 2015; Yilmaz and Bakis, 2015). Many building projects in underdeveloped nations are unsustainable. Projects are often too big for local communities to manage, maintain, or even relate to culturally, whether they are built by international enterprises, non-governmental organisations (NGOs), or a deployed military force. In poor countries, well-meaning non-governmental organisations often fail to achieve their objectives. These failures have happened in a variety of settings and situations, including non-profit organisations in Africa, water projects in South America, and military operations in Afghanistan. These initiatives fail not because of typical financial, schedule, or quality problems, but rather because they are not "socially sustainable," that is, they are not sustained by the target audience (Pococka *et al.,* 2016). The World Commission on Environment and Development of the United Nations stated that "humanity has the power to make development sustainable to ensure that it serves the needs of the present without compromising the ability of future generations to meet their own needs" (Bruntland, 1987). Edward Barbier identified the environmental, economic, and social aspects of sustainable economic development as early as 1987 (Barbier, 1987). In order to balance these three aspects of sustainability, John Elkington advocated for a "triple bottom line" that includes the duties of social justice and environmental quality in addition to profit (Elkington, 1999). Economic, environmental, and social factors—the "triple bottom line"—are all part of the modern concept of sustainable development. "A holistic process aimed at restoring and maintaining harmony between the natural and built environments, as well as creating settlements that affirm human dignity and encourage economic equity" is how Agenda 21 for Sustainable Construction in Developing Countries defines sustainable construction (Du Pleissis *et al.,* 2002).

It is possible to quantify the effects of sustainable development on variables like the rate of unemployment, the percentage of women in the labour force, the literacy rate, the average commute time, the number of violent crimes per capita, the health-adjusted life

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expectancy (Slaper and Hall, 2011), and the percentage of the population that is displaced (Natsios, 1997). Even though these sustainability indicators apply globally, developing nations may need to address additional social and human sustainability challenges. The International Institute for Sustainable Development conducted a three-year study and discovered that its programmes enhanced food security, raised the status of marginalised groups, increased access to health and education, and developed local technical competencies in addition to strengthening community cohesion and institutions through participation (Paas *et al.*, 2012). These benefits might be seen as reliable markers of a sustainable society. These advantages help to achieve the 17 lofty Sustainable Development Goals of the United Nations, which include ending world hunger, maintaining good health, providing high-quality education, minimising inequities, enhancing infrastructure, and promoting partnerships (UNSDGs, 2015). Moreover, automated control systems and sustainable architecture are often used in conjunction with high-performance, green, smart, energy-efficient buildings (Yilmaz & Bakis, 2015). But when discussing building issues concerning social, economic, and environmental aspects of communities, the phrase "sustainable construction" is the most encompassing (Kamruddin *et al.,* 2020).

Women in Sustainable Business

Women's greater participation in the labor force has been a notable trend in industrialized nations since the 1950s. Currently, women make up around 48% of workers on average, and 66% of them are economically active, compared to 80% of men. Nevertheless, there are significant differences between men and women in self-employment and business ownership, two areas where this level of involvement has not been mirrored. Eventually, it should stop talking about "women" entrepreneurs and just say that some people are business owners, regardless of their gender (Marlow *et al.,* 2012). One strategy for getting more women involved in the economy is entrepreneurship. Women-owned businesses have the potential to greatly increase household incomes and spur economic growth because, compared to men, women invest a larger percentage of their earnings in their families and communities. In Bangladesh, women who start their own businesses are more likely to have fewer children than the general population, which suggests that they are more accepting of and conscious of family planning. Even with the revolutionary impacts, women still make up a very small portion of the entrepreneurial workforce. For instance, a 2016 survey conducted by the World Bank Group Member International Finance Corporation (IFC) revealed that only 7.2 percent of Bangladesh's approximately 8 million businesses are owned by women, and 99.93 percent of them are cottage or micro, small, and medium-sized enterprises (MSMEs). Women are perceived as having a relatively limited presence in most industries, especially wholesale and retail commerce (except textiles), even among those who manage their own businesses. Second, according to a 2018 UNCDF study carried out as part of SHIFT SAARC, just 94,800 of Bangladesh's 1.3 million retail micro-merchants are women (Microentrepreneurs Asia, 2023).

Compared to few decades ago, sustainability now garners a great deal more respect and attention. As the effects of climate change become more obvious, being sustainable has evolved from being a lifestyle choice to a standard. But it is easy to forget that these kinds of behaviours are part of our daily existence. Many women have implemented this mentality into their enterprises as they become more powerful in all spheres of life. In India, women are the owners of 14% of businesses, according to a National Sample Survey Organization survey. Many of the food and beverage, cosmetics, healthcare, and textile industries are leading the push for sustainability. Businesses that supply organic, environmentally friendly, and sustainable products include Carmesi, Clan Earth, The Woman's Company, and Ruby Organics, all of which are owned by women (Bora, 2022). Not all environmentally conscious companies that produce textiles and cosmetics are run by women entrepreneurs. Even companies that help develop green buildings by using agricultural products have been founded and run by women. In addition to damaging the environment, stubble burning reduces farmer productivity the next season since it requires more input from tillers to achieve the same yield. Operating a business outside of the existing system is difficult, and it becomes even more so in an industry like construction. More startups and companies that employ agricultural goods and sustainable materials, such as hollow and construction blocks, are established with the assistance of women in business. There ought to be more pure, non-toxic ingredients. Green firm development has long been a top priority in the government's climate policies, which aim to encourage green growth. Women in particular are crucial to the establishment of a sustainable future and the preservation of the environment.

The fact that women are driving the sustainability agenda in investing and business is not surprising. As per the latest BNP Paribas Global Entrepreneur Report for 2020, a majority of female entrepreneurs—54% as opposed to 41% of male entrepreneurs—believe that reducing their carbon footprint is the most important measure of investment success. That is a crucial point. Women face many challenges in their roles as corporate executives, such as limited access, financial constraints, and barriers to diversity. It also shows how women apply their ability to overcome obstacles to new issues that are advantageous to all. At a time when the globe is struggling to recover from COVID-19 in the long run, women entrepreneurs' leadership in sustainability has reached a critical mass (Nelson, 2021). One key method to support women-owned sustainable enterprises is to show up for them, especially as the economic toll of the epidemic continues to fall disproportionately on women, especially women of color. Compared to their male counterparts,

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female business owners and entrepreneurs encounter a number of obstacles, such as a shortage of funding and a deficiency in institutional networks and contacts. That hasn't prevented these entrepreneurs from blazing their own trails and starting ethical, vegan, and ecological businesses.

Women Entrepreneur's Situation in Bangladesh

Out of the 58 economies analyzed, Bangladesh has one of the lowest percentages of women business owners—4.5 percent—just above Saudi Arabia and Egypt. A promising discovery from the study conducted in Bangladesh is that merely 20% of businesses owned by women and 40% of businesses owned by men are involved in the industries affected by the pandemic. The lowest ratio is found in the economies under study for women-owned businesses. Globally, women have been disproportionately affected by the Covid-19 pandemic; 87 percent of women business owners have suffered as a result. The top-performing economy in MIWE 2020 serves as a great illustration of how gender-specific support networks may have a big impact quickly. The Covid-19 made an already challenging situation worse. The pre-existing gender gap in business, childcare and household responsibilities, the occupations and industries women often work in, and other factors all contributed to the disproportionate impact on women's lives and livelihoods. Nonetheless, this moment in time will be fleeting unless governments, financial services, and business organizations collaborate to offer systemic support and programs that empower women to live and prosper in this new normal, give them the tools they need to navigate the digital world, and foster an accessible, equitable financial services system that supports women's work and entrepreneurship (The Daily Star, 2020).

Furthermore, Bangladesh, a nation that is rapidly developing, stands to gain the most from women's participation in the economy. Women's participation in the economy, ownership of productive assets, and control over them promote development, reduce inequality, and enhance children's health, well-being, and school attendance. Compared to males, women are more inclined to invest money back into their communities and families with a larger portion of their income. The number of women in Bangladesh launching their own enterprises has skyrocketed. However, compared to men, women manage and own a far smaller number of businesses. As per the 2013 Economic Census, the number of establishments headed by women has increased to 0.56 million (7.21%) from 0.10 million (2.80%) in 2001 and 2003. But the surge in female entrepreneurship and the characteristics, drives, success rates, and gender-related differences in their behavior are complex and multifaceted (The Financial Express, 2019).

Bangladesh Context

Presently, multistory buildings in Bangladesh are constructed using ecologically friendly building materials. The majority of these materials are earthquake resistant. Experts claim that utilising these eco-friendly building materials will help cut pollution and construction costs. Experts also think that more people will be interested in launching businesses in this industry if the government offers incentives. The Ministry of Housing and Public Works' Housing and Building Research Institute (HBRI) has been developing environmentally friendly building materials for the last three years. HBRI has created a new type of affordable and portable brick. River mud and cement are mixed together to make the bricks. Furthermore, HBRI has created unique wall, roof, and floor materials. The institute claims that the price of bricks would be cut in half with the newly developed bricks. Additionally, the authorities asserted that the specific wall, composed of cement and jute fibre, is robust and resistant to erosion. "Our engineers and architects designed the facility," HBRI director Mohammad Abu Sadeque said (Staff Correspondent, & Staff Correspondent, 2017). Compared to conventional constructions, the cost of this kind of structure is 30% lower.An estimated 25 billion bricks are produced in the nation annually. To meet the demand, 60 million tonnes of topsoil are needed. These bricks are produced by burning about 3 million tonnes of wood and 5 million tonnes of coal, which releases 15 million tonnes of carbon into the atmosphere (Staff Correspondent, & Staff Correspondent, 2017). The production of these newly designed bricks using soil from river beds will contribute to the preservation of the ecosystem and topsoil. If more government organisations involved in construction step forward, the public will be encouraged to adopt this new technology. The capital's brick kilns are the primary source of air pollution. The environment agency estimates that brick kilns contribute 58% of the city's pollution, with the remainder coming from sources like dust and traffic. The seventh five-year plan for the nation commits the government to achieving zero pollution by 2020. However, according to Staff Correspondent, & Staff Correspondent (2017), the government is not concerned about the deadline.

Government Initiatives for Eco-Block Production

The most significant component of the planet is the soil. We can live and move as we need to because of this element. Unfortunately, more people than necessary have overused the soil on Earth. Brick production employing cultivable land's soil is the most aversive usage pattern of excessive soil use. As a result, the amount of land that can be farmed is steadily declining. The establishment of traditional soil brick manufacturers and land exploitation have resulted in pollution and damage to the ecosystem. Consequently, the living areas are getting smaller every day. Nonetheless, the government of Bangladesh has mostly recognised the negative effects of excessive or inappropriate usage of soil in traditional soil brick manufacturers. As a result, the Bangladeshi government has started using blocks in its offices and structures. This notification's primary goal is to decrease the amount of dirt used in construction projects.

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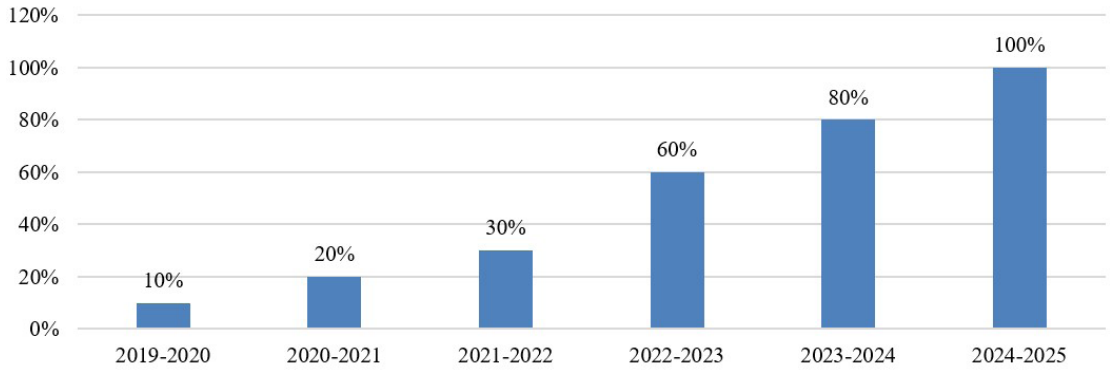

Figure 1: Government Targets for Block Using Target for Block using

It is important to remember that all government construction, repair and renovation projects aim to gradually phase out the use of soil, as allowed by Section 5 (3a) of the Brick Making and Installment of Tiles (Regulation) Act, 2013 (Amended 2019). This includes the walls and boundary walls of the building. A notice dated November 24, 2019, stipulates that in Herring Bond Road and Village Road Type-B, dollars must be used in lieu of bricks in accordance with the time-bound work plan and targets outlined in subsection 2 (99) of the aforementioned Act (MOEF, 2023). However, the goal of this paper is to learn about the current state of the industry, the potential of the project business model, the product that is currently on the market, its availability, people's opinions about it, the technical knowledge that producers and workers currently possess, the state of the environment and health issues, and the opinions of MEs.

METHODOLOGY

This work was entirely intended to be mixed method while only qualitative data were dominant for interpretation. Because there are lots of brick kilns in this district, it was chosen as the study region, much like Thakurgaon in Bangladesh. Along with, the research observed that there are huge number of people who used blocks in their contruction activities. So, the researcher used pusposive samoling method calculated based on the unknowne population. A total of 100 block users were surveyed while four focus group discussions and eight key informant interviews were also carried out by using purposive sampling method in order to gather data. A research instrument for gathering data from key informant interviews was the interview schedule. Additionally, group data collecting was conducted using a focus group discussion leading questionnaire guideline.

RESULTS AND DISCUSSION

Categories of Microentrepreneurs

In the region under investigation, the majority of business owners were proprietors of factories that made pillars, slabs, or rings. Based on the data gathered, the Ring/Slab/Pillar plant has the highest proportion of companies in the research area that produce green building materials—64 percent. The factory that made eco-bricks, hollow blocks, and tiles was the least profitable. Some companies also manufactured machinery in addition to dealing in sand, cement, and rods. Establishing production facilities for hollow blocks and eco-bricks is essential to supplying eco-friendly building materials and raising awareness of their application. Kalpona Begum, a cement pillar and sanitary materials entrepreneur from Shantinagar who participated in ME and FGD (1), expressed similar views, saying, "In my factories, I primarily manufacture sanitary ware and pillars—sanitary ware such as slabs, rings, toilet lids, and so on." I've also made the decision to begin manufacturing eco-bricks and tiles, among other building materials. Furthermore, the FGD members Pradip Kumar, Alamgir, Mustafizur, and Mahamuda stated, "Our main products are stoves, ventilators, pillars, and sanitary supplies. We have the greatest number of entrepreneurs operating this kind of factory because these are utilised in every home in our community. Yet, Md. Shafiul Alam of LGED Thakurgaon asserted that "MEs typically produce tallies, bamboo products, sanitary ware, tiles, flower tubs, pipes, pillars, and tiles." Moreover, they also sell rod, cement, and sand in retail."

Ownership and Labour Patterns Across Several Businesses

According to data from the Baseline Survey, 94% of businesses are held by a single person. The majority of these entrepreneurs acquired their ownership through self-purchase, while the remaining MEs had patriarchal ownership. There are just 6% joint ventures. This data suggests that the majority of the factories producing environmentally friendly building materials were established as sole proprietorships. The study data indicates that the majority of workers in factories that produce eco-friendly construction materials are men, which implies that all of the businesses employ men. There weren't many female employees in the businesses. Out of 100 businesses, 86 do not employ any women. In light of the foregoing data, it may be concluded that women in this industry do not yet have access to career prospects, awareness, or positivity. The workers are not competent enough to carry out the tasks related to their work since they have not gotten all of the necessary training or instruction. A restricted number of training

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sessions were made available to some MEs and their employees, but not enough to satisfy the needs. Siddique, a participant in the FGD session, said, "Young men make up the majority of the staff." Women in our area do not want to do such jobs. Not all of the employees have experience because the bulk of them lack training. Since they estimate instead of using a precise method, the product quality is frequently off.

Training, Fastest Growth Rate, and the Cause

Training is a crucial component in enhancing one's abilities in a particular area. Improving one's ability to perform particular tasks correctly is crucial. The majority of MEs had not obtained any training in the area under study, based on the data on their training status. A comparatively small proportion of the MEs—29%—had training in a range of skills related to the subject of the inquiry. The majority of those the researcher surveyed said that their capital assistance and loan support from various sources were what allowed them to expand. Large-scale enterprise expansion is encouraged by these assistances, which come from banks, other financial institutions, and non-governmental organisations. The study's conclusions indicate that an entrepreneur can greatly quicken the pace of business growth by securing a lot of grants and other financial aid in addition to receiving a lot of technical assistance. Data on the highest growth rate showed that infrastructure support was one of the most important factors for promotion and the reason for the highest growth rate.

However, the majority of MEs contended that capital support, loans, aid, technological assistance, infrastructure assistance, skilled labour forces, raw materials, and government assistance and services were the most significant factors influencing the highest rate of enterprise growth in the study area. The results of the study indicate that microenterprises (MEs) have drawn attention to a number of avenues for the enterprise's potential future expansion. These routes include making sure that markets are competitive, expanding networking and value chain development, improving efficiency, developing a competitive mindset, and building a workforce with the necessary skills. Conversely, participant in the focus group discussion Ashraful Islam *et al.* said, "I believe that the growth rate of sanitary materials is high. Government and NGO grants to entrepreneurs, low-interest or no-interest loans, and various government and NGO promotion and awareness campaigns have all contributed to the growth of this industry because people use these items on a daily basis. Similarly, Md. Rashidul Alam, a KIIs participant, said: "I think eco-bricks and hollow blocks are growing every day, even though sanitary enterprises were growing quickly." Since government action and policy will prohibit the customary burning of coal and wood in brickyards, I think companies that make environmentally friendly materials will see the biggest increase in demand in the near future.

Effect of Enterprise Earnings on Family Income

One of the most crucial components of any business is income, which is necessary for the operation of the business as well as for the MEs family's needs to be met and for their subsistence. In order to produce and develop their earnings, micro enterprises (MEs) will inevitably find and run businesses in a number of categories, such as manufacturers and suppliers of eco-friendly construction materials in the research region. On the other hand, the data indicates that 73% of the MEs in the research region earn less than one lac per month, which is the majority of them. Based on the information at hand, it is evident that the owner of the company uses the money their businesses generate to meet a number of needs. Most of them are able to meet the basic needs of their families, and they use the money they make for things like buying a house, farming, and raising different kinds of crops. However, the majority of MEs felt that by supporting land purchases, domestic animal husbandry, farming, and agricultural production, their enterprises helped meet the needs for nourishment. As a result, MEs were essential in guaranteeing that households in the research area had access to the resources required to satisfy both their basic needs and wants. However, another participant in the FGD, Mr. Ashraful Islam from Salandar, said, "My family's needs are met by the revenues from my building materials business. For me, it is really essential. Mr. Shafiul Alam, a KII participant, said in a similar manner, "Even though several owners run separate enterprises, this has a huge impact because the firm generates the majority of income. A key factor in increasing household incomes is factories.

The study revealed that the majority of MEs said they were knowledgeable about environmental pollution and the state of the environment at Enterprise. Many of them thought that air, sound, and black smoke pollution were the root causes of environmental contamination. Nevertheless, some of the MEs believed that scattering dirt here and there was the cause of environmental contamination. We can conclude that the MEs who were aware of environmental pollution considered that black smoke, natural disasters, air and sound pollution, improper handling of dirt, etc. Nearly all of the businesses have some sort of environment and social safety system in place. Among the safety measures were donning facial masks, keeping a physical distance, providing first aid, and appropriate waste management. Nonetheless, a startlingly high percentage of businesses adhered to safety protocols. However, some of the businesses didn't give it a second thought, and the number is definitely not negligible. Waste management is essential to maintaining a healthy and conducive environment for all living things on the planet. However, a sizable section of the global population suffers from a lack of waste management knowledge, which causes them to improperly manage garbage in their businesses. Though not very high, the number of MEs that generated garbage within their

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businesses is not insignificant. Upon examining the waste management strategies employed by the MEs, it was noted that the pollutants created by the MEs in the research area varied. Additionally, it was noted that certain MEs had adapted the correct method of disposing of it. The majority of MEs (74.7%) in the research area kept waste and rubbish in separate locations, according to data on waste management practices. The study area's MEs were found to be confronted with a multitude of ecological challenges due to environmental constraints, such as unfavourable weather patterns, natural disasters, insufficient support for disaster preparedness, frequent rainfall, and increased pressure from government environmental authorities. However, because there aren't many MEs that burn their waste or discharge it outside, the soil and air may occasionally become contaminated. However, they asserted that it is rare. Regarding environmental difficulties, Khademul Islam and A B Siddique (FGD2) held similar opinions: "Most of the industrial process is environmentally friendly. As we adhere to best practices for the environment, I can state that there is no pollution. No components that harm the environment are employed in our plant's construction material manufacture. Consequently, there is no chance that the air, soil, or anything else I'm referring to may get contaminated. "Many of them were under the impression that the enterprises were only responsible for a negligible amount of the environmental damage caused by black smoke, air, and sound pollution," stated Md. Rashidul Alam of LGED Thakurgaon, another participant in the KII programme.

Lockdown Nationwide and COVID-19's Effects on the Enterprise

The study's conclusions show that a sizable portion of companies decided not to fire any workers due to COVID-19, even though the virus caused other employees of those companies to be let go. Order cancellations during COVID-19 were found to have occurred in large numbers. This directly led to a considerable decline in the company's overall sales throughout the COVID-19 period. The companies' declining sales during the pandemic had an impact on the families' financial situation and social standing. In spite of this, a sizable segment of the MEs claimed that COVID-19 negatively impacted their personal and familial life. Furthermore, one of the FGD participants, Mr. Md. Abdul Latif, stated that "Since no businesses were open during Thakurgaon's lockdown, the enterprise's products went unsold, and the owner reduced the number of employees by cutting worker salaries." In summary, smaller and medium-sized firms were heavily impacted by COVID-19, and they will likely have a tough time recovering. According to Abdul Kader, during KII, "Covid-19 has already caused a significant disruption in the business; as a direct result of Covid-19, MEs have reduced the number of staff members and suffered significant financial losses in their enterprises." Furthermore, current workers have experienced a salary cut directly related to the market closure; consequently, they are asking for financial assistance in order to maintain their businesses."

Source of Help and Encouragement Received by the Business to Make a Change

Any activity involving micro-enterprises needs assistance in order to be executed correctly and smoothly, but this is especially true for those operations. Micro-businesses (MEs) rely primarily on the assistance and support of different parties and stakeholders in the areas where they operate for their growth and development. However, the real problem lies in the study's statistics, which showed that just 2% of MEs received financial support during COVID-19, and that the vast majority of MEs did not receive any aid at all. This is actually the case. Even though it was very difficult for them to do so, MEs were compelled to manage their enterprises and maintain their families because they were not provided with any financial support under COVID. However, Futani Bazar participant Ratan said during the focus group discussion (FGD) that "We received no grants or financial assistance from any government institution." The government provided aid during the COVID-19 pandemic, but the majority of MEs did not receive it since funds were set aside for the most vulnerable residents. Only banks and non-governmental organisations have provided loans to MEs. Basically, the name ESDO comes first when I talk about receiving support. It gave us the financial and technical support we needed to manage and operate our factories."

The Issue with Input and Output Level

Most MEs experienced problems with transportation or carrying facilities, significant pricing concerns, and problems with the availability of services for raw materials that were classified as high. To put things into perspective, transport infrastructures are very expensive. The results of the investigation showed that the MEs had multifaceted issues with the input level. The availability of raw materials for manufacture presented the MEs with a great deal of difficulties. MEs had to overcome a range of difficulties, from marketing to manufacture. It was found that certain MEs were handling really significant problems in their product markets. The study's conclusions indicated that transport facility expenses, inadequate product pricing, and excessive costs associated with product promotion were the main issues facing micro, small, and medium-sized companies (MEs). However, Mr. Kader, a KII participant, said that "The prices of goods that have already been made were rising faster than the prices of raw materials." High transportation costs result from the inability to locate certain raw resources locally. In the beginning, there was also a shortage of competent labour, inexperienced entrepreneurs, low access to credit from financial institutions, and a lack of cash."

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Issues at the Credit Market level

A wide range of diverse forms of support are needed for the expansion and development of MEs. These support options include financial assistance in the form of loans and credit, as well as technical assistance and help for the construction of infrastructure. As their companies expanded, a lot of SMEs concluded that they needed funding. The majority of the MEs had not encountered any issues that were significant at the credit market level, based on survey data gathered in the research region. KII participant Mr. Shafiul, on the other hand, said that "Getting a loan from a bank is a complex and time-consuming process. They have strict production requirements that can be challenging for a small business owner to achieve when they first launch their enterprise.

Future Requirements for MEs to Grow Their Businesses

The MEs in the study area made several expectations about the growth and management of their businesses. Data on the MEs' future requirements, however, demonstrated and supported funding for the construction of infrastructure, which might entail the opening of businesses, factories, or storage facilities, as well as funding for future economic support, which might take the form of grants, loans, or other forms of financial aid. Conversely, a comparatively little segment of the participants had never needed this type of support. Furthermore, the statistics indicated that the majority of MEs were asked to support the growth of their human capital by offering training and development services to their staff. In light of the discussion that has just concluded, the EMs situated in the research region most urgently need help with economic development, support with infrastructural development, training, and environmental enhancement. Nevertheless, Tofazzol Hosen, a ME who took part in the FGD, said, "We need government funding first and foremost. We produce environmentally friendly building materials in our enterprises that are entirely novel to the general public. The significance and advantages of utilising these items in home construction must be promoted by government initiatives. Similarly, Md. Shafiul Alam, a KII participant, said that "The government should give a helping hand and provide training facilities for producing eco-friendly construction materials in this region in an effort to assist MEs in expanding and promoting the business in the future." Large NGOs' financial and technical contributions may have a significant influence on the growth and development throughout time.

Indicators for Monitoring and Evaluation

It aims to raise a project's or business's effectiveness and efficiency. It alerts management to problems and keeps the project on track. Efficiency can inform you if the input was appropriate given the result. Resources that could be utilised to input this include cash, labour, machinery, and other resources. The degree to which a development initiative or programme meets its goals is a key indicator of its effectiveness. The study tried to identify the indicators of M&E from the perspectives of the KII participants, even if they were unaware of it. Things like the quality of the materials or items, sales and production, the working environment, health and safety, etc. are all seen as noteworthy indicators. Md. Ashraful Islam spoke on this topic, saying that environmental standards "must be seen as critical indications when monitoring and evaluating these businesses." In addition to this, other factors like worker comfort and the quantity and quality of the output should also be given priority. Similar to this, Majedul Islam Mamun stated: "It is essential to monitor the quality of both the raw materials and the final goods, in addition to the workplace's cleanliness and other environmental norms. And the Department of Environment needs to take preventative measures to ensure that."

Government Moves Forward with EFB

The absence of any enforceable actions has contributed to the proliferation of brick kilns worldwide over the past few decades. This is not to say that brick production is not governed by laws. It was challenging to apply terms under the Brick Burning (control) Act of 1989 due to its flaws, and the situation was exacerbated by enforcement gaps for some compliance issues. Consequently, the practice of creating brick plants met with no resistance anywhere. According to estimates from the Department of Environment, there are around 6,500 brickfields throughout the country. Environmentalists, however, speculate that the figure might reach 10,000, with half of them centred in and around the country's capital. According to a long-ago Asian Development Bank (ADB) figure, the country produces 22.71 billion bricks annually (Mmojica, 2018). According to a World Bank report, this leads to the brick kiln industry burning 3.5 million tonnes of coal and 1.9 million tonnes of firewood year and producing 9.8 million tonnes of greenhouse emissions (Eco-friendly brick making, 2021). Experts and environmentalists say that one of the disheartening realities is that the country's insufficient arable areas are increasingly being encroached upon by brick fields. Because the brick making companies are close to agricultural areas, the damage caused by their heat, caustic smoke, and dust is particularly serious. Brickmakers are subject to several strict requirements as per the previously mentioned statute. This did not function as things stand currently, mostly due to the demand-driven nature of the building business and a lack of enforcement.

Brick production is governed by laws that were passed by the government a long time ago. Preserving arable land and woods while putting an end to widespread environmental contamination was the aim. The Brick Making and Brickfield Establishment (Control) Act of 2013 is a new legislation that was passed to regulate the production of bricks. After two changes in 1992 and 2001, the Brick Burning (control) Act of 1989 was replaced by a new law with stricter regulations. One of the more stringent

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measures for brick manufacture brought about by the new law is the requirement for trials for crimes under the penal code. The environment court has previously heard the offences. Those who are breaking the law, it appears, have avoided being apprehended thus far. According to experts, the legislation outlines the places that shouldn't have brick factories and covers every facet of making bricks in a rather thorough manner. Even though the law has been in effect for a while, it is still unclear exactly what makes compliance with it difficult. Up until now, there has been no real attempt to enforce the rule other than the occasional newspaper story about brick factories being torn down. Is the attractiveness of leniency over enforcement due to the demand-driven factor? If so, the authorities need to think of other ways.

In this regard, it is important to note that the development of alternative brick—as opposed to bricks produced in traditional kilns—is a praiseworthy attempt to meet the demand for bricks. Furthermore, this is in line with the government's plan to gradually reduce the manufacture of conventional bricks. Clean bricks, sometimes referred to as green bricks, are used in construction as a less expensive alternative to kiln-baked bricks in many countries. A local newspaper recently discussed compressed earth blocks, which are composed of dirt and cement, as a potential substitute for bricks produced in kilns. Experts estimate that adopting these bricks will not only be ecologically friendly but also reduce construction expenses by roughly 25% to 30%. The government's Housing and Building Research Institute (HBRI) is credited by the newspaper with launching the campaign by highlighting the benefits of adopting green bricks. Instead of being cooked in kilns, cement and riverbed soil are combined to manufacture these bricks, reducing pollution and damage to agricultural areas. The HBRI has been developing alternate bricks for a number of years, and both public and commercial organisations have started using them. The most important thing about these bricks is that they are pollution-free because they were made without the use of firewood or soils. Everything is different now that we have access to green technology. At the very least, the potential of creating environmentally friendly bricks is offered, and there's a good chance that the alternative brick will be utilised more frequently because of its superior technology and reasonable price. Reports state that the technology has a high initial cost. It is imperative that the government gradually phase out the outdated kilns and provide the necessary backing in the form of long-term loans to encourage the use of green technology, considering its efficiency, affordability, large production capacity, and most importantly, its emission-free mechanism. Furthermore, incorporating a provision in the National Building Code that permits the use of green bricks could aid in encouraging the adoption of this innovative technology.

EFB's Economic Feasibility

When evaluating equally technically competent construction solutions, an economic analysis of a construction project helps to determine whether the financial resources being deployed are feasible in terms of original investment and/or future costs (maintenance, etc.). The planning, design, and construction stages of a building project include making a number of decisions, many of them purely financial in nature. Still, additional considerations are taken into account while making decisions, including the environment, society, politics, and aesthetics. It is imperative to acknowledge that a building's design has a substantial impact on its future performance, operational and maintenance expenses, and total cost. Life cycle cost must be embraced from the outset of the project in order to support decisions that can be reflected in how the building is used. The owner's wants and goals will determine the level of detail in this research, which could include a thorough investigation of the building's concept or the selection of potential building materials or construction techniques (Liliana Filipa Viana Soares (Retrieved on 2023).

A recent UNDP survey indicates that over 33% of the fuel used in the country's seasonal brick kilns comes from fire wood. The Bangladesh Brick Manufacturing Owners Association (BMOA) estimates that there are roughly 8,000 brick farms in the country that produce bricks in different grades. The Roads and Highways, Public Works, and Local Government Engineering departments are only a few of the government agencies that use more than 60% of the bricks produced in the country annually. The remaining is used by users in the private sector. 0.8 million people are employed in the brick manufacturing industry off-season, and roughly 2 million during the peak season, according to BMOA. The country produces approximately 8.66 billion bricks a year, and during the last ten years, the industry has grown at a 5.3% annual pace, according to a UNDP source. Nonetheless, there is reason to believe that the country produces around three times as many bricks annually as was previously thought. Brick kilns in Bangladesh produce six to nine million tonnes of CO2 annually, making them a major source of greenhouse emissions. The reason for these high emission levels is the employment of outdated techniques and subpar fuels, such as tyres, high sulphur coal, and wood used in kilns. The situation is getting worse every year as more brickfields are being added. Replacing outdated brick kilns with new ones quickly is a difficult undertaking, even with technology that has been shown to be able to manufacture high-quality bricks while using only a third of the fuel (coal) compared to conventional FCK or BTK. The cost of installing a zigzag kiln is around Tk 3 million, which is twice as expensive as that of a fixed chimney brick kiln (land price or rent excluded). If the cost of the land is not included, installing a hybrid Hoffman kiln could cost between Tk 80 and Tk 100 million (Iqbal, 2016). BTK, FCK, and Zigzag brick kilns can operate in both high and low areas because they are seasonal kilns. Brick kilns, both Hoffman and Hybrid Hoffman, are usually built in the highlands.

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In order to improve brick kiln technology in Bangladesh, UNDP started providing technical assistance with financing from the Global Environment Facilities (GEF) initiative. In this architecture, seven Hybrid Hoffman Kilns are located across the country and operate year-round to produce high-quality bricks using a much reduced amount of coal. These programmes are encouraging new entrepreneurs to imitate the eco-friendly brick kiln technology. The HHK technology is being successfully adopted with assistance from the Chinese Xian Design Institute of Wall and Roof Materials. Among other things, HHK utilises pulverised coal and clay to make green bricks. This method can help reduce fuel use and greenhouse gas emissions when burning brick. Over 80% of the energy required to burn bricks in HHKs is reportedly supplied by the coal and clay mixture used to create green bricks. The 20% residual coal in the fire chambers of the specially designed hybrid Hoffman Kiln is fed from outside (Iqbal, 2016). Nearly all of the coal needed for burning and making bricks is burned in the kiln due to efficient air circulation. The system also includes preheating arrangements for the green bricks in the stacks inside the appropriately insulated drier chambers, which are aided by exhausts from the last kiln fire that are channeled into the dryer chambers.

To its effective drying and burning method, HHK only need 13–14 tonnes of coal to make 100,000 high-quality bricks. A single HHK unit could produce between 50,000 and 45,000 bricks a day. An HHK can thus be used in place of five to seven classic FCK, BTK, or Zigzag kilns because it can operate year-round. HHK demands a Tk 100–110 million initial investment, which includes the land's cost. In comparison to FCK or BTKs, the HHK saves 9–10 tonnes of coal when burning 100,000 bricks, enabling the business owner to obtain the carbon credit from the global carbon trading market. By producing 15 million bricks internally, an HHK may be able to earn over Tk 700,000 in carbon credits annually (Iqbal, 2016). Reducing carbon emissions is an additional benefit of producing and selling bricks, in addition to the usual financial returns. Implementing an environmentally friendly brick manufacturing process requires financial viability.

Comparison Data in Terms of Quality

Due to a lack of testing procedures, it was difficult to determine the quality of the items (bricks) in the research region. The owners of every brick kiln in the research areas were unaware of the need for testing to guarantee the quality of the product. They showed no regard for the pollutants that their brick kilns were releasing into the environment. They were ignorant of the adverse effects of conventional brick kilns. The majority of them believed that traditional brick kilns had negligible environmental effects. Unplanned usage of the soil's surface as raw materials for brick-making by burning trees for fuel did not bother them. Furthermore, none of the brick kiln owners in the research locations had adopted testing protocols for their goods, hence there were no testing facilities there. The brick kiln owners believed that their business would be lost if brick was tested. They also gave more attention to financial success than environmental preservation. But some bricks were examined, and the findings were as follows:

Category	Block Size	Test Name	Results
Solid Block (Eco-Brick)	(9.5x4.5x3) Inch	Compressive Strength (psi)	395psi
		Water Absorption (%)	10.45%
Hollow Block	(16x8x4.5) Inch	Compressive Strength (psi)	675psi
		Water Absorption (%)	11.54%
		Compressive Strength (psi)	405psi
		Water Absorption (%)	10.95%
Hollow Block	(400x200x113) mm	Compressive Strength (psi)	480psi
		Water Absorption (%)	12%
Solid Block (Eco-Brick)	(238x113x75) Inch	Compressive Strength (psi)	1850psi
		Water Absorption (%)	10%

Following testing, it was discovered that eco-brick was more pressure-resistant than current goods. Furthermore, in the research region, eco-friendly bricks, such as hollow and solid blocks, absorbed less water than non-eco-friendly blocks. As an illustration, consider the Solid Block (Eco-Brick) measuring 238 by 113 by 75 inches, which has a 10% water absorption capacity and a compressive strength of 1850 psi (HBRI, 2022).

CONCLUSION

The building industry has faced significant safety challenges, leading to disastrous results. Addressing environmental challenges head-on is crucial for a sustainable construction sector. Micro-entrepreneurs (MEs) in the paper industry face various challenges, including access to production, raw material gathering, packaging, marketing, and operational issues. Demand, supply, marketing, and awareness influence their growth. Sanitary product manufacturers are in high demand due to government awareness campaigns, customer demand, availability, sales rate, and subsidies. Businesses making eco-friendly pillars, tiles, and cooking stoves are expanding. MEs are aware of environmental pollution and have safety measures in place. However, government

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support comes from non-governmental organizations. During pandemics or economic downturns, entrepreneurs borrow funds or obtain loans from various sources, often facing transportation, carrying capacity, and costing issues. The main demands for MEs are financial support with low service costs and training for workers and owners in environmentally friendly building materials production.

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