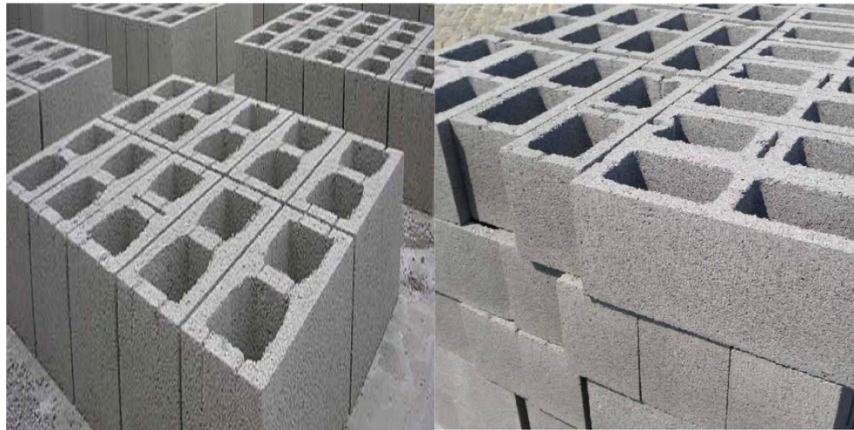


Study for Exploring, Innovating, Mapping and Interventions of Developing Micro-enterprise
on Environment Friendly Construction Blocks Materials and Technologies Sub-sector
Package no: PKSf/SEP/S-14.2

Final Report

Palli Karma-Sahayak Foundation

Small Assignments
Lump-Sum Contract
(IDA Credit No.: 6209-BD)



Sustainable Enterprise Project (SEP)
Represented by Palli Karma-Sahayak Foundation
E-4/B, Agargaon Administrative Area,
Dhaka-1207

16 May 2022

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1.0 EXECUTIVE SUMMARY

1.1 Introduction:

Palli Karma-Sahayak Foundation (PKSF) was established by the Government of Bangladesh in 1990 as an apex organization for poverty alleviation through employment creation. Since its inception, PKSF has been implementing various programs and projects for poverty alleviation through its Partner Organizations (POs). At present, PKSF has more than 250 Partner Organizations throughout the country.

Based on the success achieved and lessons learned from previous projects, with the help of the government and financial support from the World Bank, PKSF is implementing 'Sustainable Enterprise Project (SEP)'. This is a five-year project aims to increase adoption of environmentally sustainable practices by targeting 40,000 Microenterprises (MEs). The goal of this project is to increase the adoption of environmentally sustainable practices by targeted MEs. Project Development Objective is to increase the adoption of environmentally sustainable practices by targeted MEs. Environmentally sustainable practices are defined as- a) business practices ensuring resource efficiency b) low pollution c) improved climate resilience.

Bangladesh is a severely land scarce country having per capita cultivable land is only 12 decimals. Moreover, Bangladesh is losing 1% agricultural land annually mainly because of unplanned rural settlements and production of clay burn bricks using fertile top soil. Such high rate of land loss will not only hamper agricultural production but will have adverse impact on food security. Additionally, production of bricks is destroying forest by burning wood as fuel. Government is moving positively towards phasing out of clay burn bricks by June 2025. Moreover, our country experiences various disasters almost every year. Flood, River Bank Erosion, Cyclone and Tidal Surge are most common hazards Bangladesh experiences frequently. Planned rural multistoried (at least two storied) houses using eco-friendly alternative technology can conserve the agricultural land as well as reduce greenhouse gas emission. Uses of alternative technology can also help for conservation of forest by reducing the use of fire wood as fuel in brick kiln. Moreover, it is possible to replace wooden door-window frames and furniture by adopting alternative technologies.

After reconnaissance survey, following four Upozilas were studied:

- Dhaka Division - Gazipur district – Gazipur Sadar Upozila
- Chattagram division - Noakhali district - Begumganj Upozila
- Rangpur division - Dinajpur district - Khanshama Upozila
- Khulna division - Khulna district – Khulna Sadar

1.2 Methodology:

A specific approach was developed to meet the requirements set by the terms of reference. These are:

- I. Study Design
- II. Study Area and Sampling Procedure:
- III. Sampling procedure and Data Collection Tool
 - a. Quantitative Component
 - i. Target Group
 - ii. Sample Size Formula
 - iii. Sample Size

- b. Qualitative Component
 - i. Questionnaire Survey
 - ii. Individual In-depth Interview (IDI)
 - iii. Key Informant Interview (KII)
 - iv. Focus Group Discussion (FGD)
 - v. Document Review
- IV. Test Sample Collection
- V. Innovation
- VI. Data Analysis Plan

1.3 Data Analysis and Findings:

Analyses and Findings of the Survey Results

This chapter presents quantitative and qualitative findings obtained from household surveys, IDIs, KIIs, FGDs. It is to be mentioned here that household surveys were limited to pucca and semi-pucca house owners.

Quantitative findings of the study:

General characteristics of the participants:

The socio-demographic characteristics of the 161 participants are presented in Table 1. The mean (\pm SD) age was 43 ± 11 years, almost 88% were male and nearly 9% had primary school or less education. Respondents in the Gazipur and Dinajpur areas tended to have higher educational levels than those in Noakhali and Khulna areas. Most of the participants (41.9%) were worked as casual workers. In Gazipur area, 55% worked as private workers where 66.7% of the respondent worked as casual workers in Khulna area. 40% of the respondent worked as businessmen in Dinajpur area. Average annual income of the respondents varies from study areas, overall 40.5% of respondent's average annual income was above 2 lakhs.

Study shows that all of the households were pucca in Gazipur (100%) and semi-pucca in Dinajpur (100%). Noakhali and Khulna households had a mix of pucca and semi pucca houses, however, very few (5%) of houses were shanty/Katcha in Khulna.

Brick and timber are produced and available in all four study areas but sand is available only in Dinajpur and only 8% in Gazipur. Noakhali and Khulna has no sand available because of absence of river and river bed sand respectively.

Housing material characteristics, materials used for different parts of the house. Cement, brick, sand and rod are the most commonly used roof, flooring material, walls, and pillar/column materials in the pucca houses of all four study areas. On the other hand, for a semi-pucca house, cement, brick and sand are equally used materials. Additionally, as roofing materials, timber and tin are also used.

Density of pucca and semi-pucca households in the study areas are not uniform. Gazipur and Noakhali having more pucca houses indicate the demand of more bricks in compare to other study areas. All houses of sampled households are of semi-pucca in Dinajpur indicates that more and more people there build semi-pucca houses rather than kutcha house. Therefore, demand of brick also more in Dinajpur. With the increased per capita income, more and more pucca houses will be in the surface demanding more brick and alternative to bricks.

Maximum brick was used in plinth floor, external & internal wall and also in the pillar which indicates more or less equal demand of bricks in all the four study areas. Use of tin in Dinajpur is more than that of other study area. But tin has lot of disadvantages as

building material such as uncomfortable indoor environment, short life, frequent repair and maintenance etc.

Satisfaction was assessed from the point of view of respondents. This measure had five categories: very unsatisfied, unsatisfied, partly satisfied, satisfied, and very satisfied. The Gazipur respondents were satisfied with the roof materials (100%), where the majority of respondents from Khulna (77.5%) and Noakhali (34.1%) were very unsatisfied. The majority of the Dinajpur respondents (100%) were very unsatisfied with the roof material. About column/pillar materials majority of the respondents of Gazipur, Khulna and Dinajpur were satisfied. Similar satisfaction level also expressed by the respondents for floor, external and internal wall.

Brick chips used as coarse aggregate in the roof concrete of pucca house whereas cement and sand are used as binding materials and fine aggregate. On the other hand, wood and tin are used in the roof for semi-pucca structure. Respondents are very unsatisfied with roof materials in Dinajpur and satisfied in Gazipur mainly because of roof material and technology. Study sample in Gazipur houses are made from concrete roof and that of Dinajpur are tin & wood. From this study it is evident that people are not happy with transitional house made of tin & wood houses. Respondents from Noakhali and Khulna also expresses their satisfaction for reinforced concrete roof and dissatisfaction for temporary tin roof.

As per as floor material, all most all floors of the study area are made from brick, cement and sand. Only very few are made from mud in Khulna and Dinajpur. Usually pucca floor are made in two layers. First layer is brick flat soling on compacted non-cohesive soil and then final layer is the cement concrete (CC).

Unlike roof materials, floor materials are liked by almost all respondents and expresses their satisfaction. Even then, major constituent of the pucca floor is brick which emits substantial amount of carbon and government's policy is to phaseout this brick from the market.

Material used in the external walls of the houses. Similar to floor, main constituent of external walls also bricks, cement and sand. Brick masonry is the only available technology at this moment for external walls which is more hygienic than conventional tin walls. Almost all respondents are satisfied as seen in the figure 6.9 with external wall materials such as brick, cement and sand. We know that brick is not an environment friendly building material and government's policy is to discourage clay burnt brick, concrete block masonry might be the appropriate alternative to brick masonry.

Brick, cement and sand are the materials for internal walls. Gazipur and Dinajpur have no tin wall but Khulna and Noakhali have few walls made from tin. Because of presence of few tin wall as internal wall in Khulna and Noakhali, five percent and two percent respondents respectively opined their partly satisfaction. Respondents from Gazipur expresses very satisfied whereas Dinajpur expresses satisfied. On the other hand, about 80% respondents from Khulna expresses satisfied and only 20% expresses very satisfied. More than 60% opined very satisfied in Noakhali.

Properties of building materials and technologies, which the respondent would like to improve. Respondents were comfortable with the improved materials instead of the existing materials, they were using currently. The Respondents in Khulna emphasized to improve durability (100%), resistance to external force (100%), better Ventilation (95%), and resistance against insects (82.5%) properties of new building materials and technologies. Similarly, respondents of Gazipur, Noakhali, and Dinajpur wanted to improve durability, resistance to external force, and better ventilation technologies.

However, respondents in Khulna wanted to improve resilience to disaster (70%) especially cyclone and salinity compared with other study area respondents.

Qualitative findings of the study:

This section includes the qualitative information collected from the participants using range of interviews including in-depth interviews (women: 4, men: 4), key informant interviews among plant conservation officer (n=2), civil engineer (n=2), construction professionals (n=2), personnel of HBRI, PWD, LGED (n=2), and focus group discussions (women: 1, men: 1). The IDIs were conducted among the household owner, builders, vendors, businessmen residing in the study areas. Key informant interviews were conducted among the owner of the business cluster, sector experts, civil engineer with relevant experience, mason, brickfield owner, supplier, block manufacturer, social formal/informal leaders. And focus group discussions were carried out among engineers, business person, environmentalist, agriculture officer, supplier, contractors, masons, etc. The qualitative findings are summarized in the following themes and sub-themes.

Natural Hazard/disaster in study areas:

Gazipur and Dinajpur are vulnerable to earthquake. On the other hand, Khulna and Noakhali areas are more prone to strong wind of cyclone.

Overall Awareness Level:

Overall awareness level is fair but not excellent. The concept of semi-pucca construction as assumed safe is not true because of its vulnerability against earthquake and strong wind. Respondents are aware of cyclone and flood only but not at all earthquake hazards. Blocks as improved material are most suitable for earthquake and strong wind resilient walls specially for semi-pucca structures because blocks are friendly to build a reinforced wall. The concept of disaster resilience house as durable and sustainable is perfectly alright.

Present practice of construction materials and Technologies:

Present practices of construction technologies of pucca houses with pucca plinth, brick wall and reinforced concrete roof and that of semi-pucca house with pucca plinth, brick wall and tin sheet roof on wooden/steel angle frame. It needs to be mention here that brick and tin are not environment friendly and sustainable building material now a day people are using. Concrete blocks and ferrocement technologies might be the appropriate alternative sustainable solution.

Source of Raw Materials for Improved materials:

Dinajpur and other northern districts have the source of sand from river bed but for Gazipur, Noakhali or Khulna do not have the dredged sand for production of concrete block. Therefore, huge part of the country needs to carry sand and stone as raw material for concrete block. Compressed Stabilized Earth Block (CSEB) is another improved material which need fine sand and silt with cement. Raw material for CSEB is available in some extent at Khulna during rainy season (low salinity) & Gazipur but not Noakhali. Therefore, MEs of Noakhali needs to import raw materials for both concrete block and CSEB from other districts. MEs of Khulna also need to carry raw materials from other districts except for CSEB in some cases.

Prospect of Micro Enterprise Development:

At present the only construction material for wall is brick. Government is very keen to come out from using brick as construction material because it causes environmental pollution as well as loss of agricultural top soil. Government also planned to use concrete blocks as an alternative to conventional bricks. Presently Bangladesh consumes more or less 20 billion bricks per annum. Therefore, it is important to make necessary arrangement to make concrete block available all over the country. The concept of microenterprise development might be one of the most effective means. Hence entrepreneurship development is a must and DPHE model may follow. Therefore, prospect of microenterprise development for concrete block production is huge.

Appropriate Construction Materials for Study Areas:

No judicious ideas came from the respondents regarding appropriate construction material for the study areas but they provided information on available raw materials and necessity of the usefulness of improved materials. Conventional brick serves their purpose nicely. So, any alternative is acceptable to them if it serves the same purpose as of bricks.

Availability of the raw materials is the determining factor for appropriateness of the improved material for a particular area. As an example, it may be cited here that concrete block would be the best appropriate options for areas where coarse sand is available as raw material. Suitable sand is available for concrete block in and around Dinajpur and other northern districts. Suitable sand for making block are not locally available in all others areas under study. Therefore, production cost will be higher in these areas in compare to Dinajpur. Even than concrete block is the appropriate building material for all study areas.

Environment Friendly Construction Block Market:

Though present market is not enterprise friendly but there are scopes of future market of concrete blocks and some other alternative. Since most of the materials including brick, cement, rod, steel, etc. used as construction materials have not very good insulation property, some people were producing blocks as an alternative. People are generally reluctant to go for improved materials like block materials mostly because of the money factor.

It is necessary to make people understand environmental aspects as well as the durability of the materials. The dangers of loss of fertile agricultural land, carbon and heat issues need to be told to people to convince them to go for environment-friendly and durable alternative construction materials.

Availability and Training and Skill of Construction Professionals:

At present, mason and bar binders are available all over the country but they are some extent trained and skilled for working with conventional clay burn bricks. To work with concrete block and other improved materials, it required to train masons and bar binders.

Institutional Respondents are 1) Department of Environment (DoE) 2) Housing and Building Research Institute (HBRI) 3) Public Health Engineering Department 4) Public Works Department (PWD).

Analysis and Findings of Soil Test Result:

Soil/Sand other than agricultural top soil have been collected from the study areas to check the suitability of alternative sustainable building materials to replace conventional clay burn bricks and to facilitate Micro-Enterprises. Collected samples have been tested in the laboratory at Dhaka. Test result reveals the fact that northern Bangladesh upstream river bed soils are of relatively coarser grain in size. As we go towards south of Bangladesh, river bed soil size gradually becomes finer. River dredged soil collected from Dinajpur and Rangpur are of more or less same property. Test results shows that collected soils are good quality sand which is suitable for manufacturing of Concrete Block (CB). Since carrying cost is minimum, most economical solution for alternative brick might be the concrete block products such as solid block, hollow block, paver block etc.

Certification and Access to Premier Market:

For sustainable enterprise, most important issues to take into considerations are product quality, product sustainability, certification and registration. Only quality and eco-friendly products would be eligible for premium market. Installation of clay burn brick production kiln required 'No Objection Certificate' or clearance certificate from the Department of Environment (DoE) and for trading or marketing, it needs license/registration from appropriate authority. On the other hand, environment friendly block production factory does not require any clearance certificate from DoE. Bangladesh has no updated standard on block from BSTI but there are PWD (Public Works Department) standards. Therefore, block producers and dealers should be aware of the prevailing standards and certification.

Increase Eco-labelling:

As a product, block is an environment friendly building material. But there are lot of other issues associated with the production process and marketing of blocks. Block production requires use of cement and electricity which causes carbon dioxide emission in the environment. A green block manufacturing business contributes to climate protection by lowering its carbon emissions, using renewable energy, reducing use of cement and ground water, effective noise control, using recyclable material and growing plants and trees around the premise. Eco-labelling is an important initiative, though not mandatory, for the promotion and sale of products to the premium market.

Environmental Clearance Certificate issue and renew from the divisional or district offices of the Department of Environment. Proposed manufacturing factory must get Environmental clearance certificate to continue business.

The common benefit includes:

- (a) meeting the legal obligation,
- (b) pollution control,
- (c) privilege of getting certificate as 'Environment friendly' entity, and
- (d) Ensure and promote sustainable development by branding and access to the premium markets.

It will not be mandatory to have registration from BSTI because it does not fall under the mandatory items of the institute. At present, there is no bar for marketing concrete block product without certification from BSTI. But one can apply for BSTI certification which

will be a lengthy process because BSTI has no set standard yet. Public Works Department (PWD) has its standard for Concrete blocks. It would be wise for MEs to follow PWD standard for getting access to premium market (Government works and large development project). Test results from recognized laboratories may help MEs to get access to the premium market.

Small-scale production: Small enterprises for producing block for local market and not for premium market will run under trade license issued by the local authorities like City Corporation, municipality or union parishad. The trade license needs to be renewed annually. Apart from trade license, each ME is required to have TIN (taxpayer identification number) certificate and VAT (value added tax) registration. Any MEs plan to run its business on a rented property need to make written deeds on judicial stamps with the owners. In addition, MEs may require documents of electricity supply, gas supply and water supply where needed.

Non-revenue Generating Physical Activities are:

- Structure for storage of raw materials such as cement, sand etc.
- Structure for production plant
- Dump yard for recyclable rejected blocks
- Construction of office building with furniture, computer, office equipment
- Construction of shed, toilet and sanitation system for buyers and sellers
- First Aid Box with medicine
- Installation of deep tube well for ensuring pure drinking water at factories
- Sanitation system development for buyer and seller
- Waste dumping pits and waste management system
- Firefighting devices
- Infra-structure for Research and Development (R&D) facility including testing lab
- Infra-structure for of Consultation and Training facilities

Revenue Generating Common Services are:

- Advertisement (billboards, posters, leaflets and flyers, sponsoring, etc.)
- Branding (E-commerce platform for branding and Market Promotion)
- Certification (BSTI, quality testing, etc.)
- License
- Training
- Website development and maintenance
- Instalment of routine testing facilities
- Generator for emergency power for uninterrupted production
- Pickup/Truck/Boat for block carrying
- Solar Panel for common purpose electricity
- Tools and instruments for machineries trouble shooting repairs
- Functioning and Operating R&D facility including testing lab
- Functioning and Operating Consultation and Training facilities

Findings of the Study:

General findings:

Housing type in Bird's Eye View shows the density of semi-pucca structure is more in Dinajpur than that of other areas. On the other hand, Gazipur and Noakhali show more pucca houses. Currently used construction materials are available in the market to all areas and all pucca houses are built with brick and that of semi-pucca houses with brick, CGI sheet and wood. One good finding is that common people are much aware of negative impacts of clay burn brick production and also many people aware of the fact that government policy is to phase out clay burnt brick by June 2025.

No house made from block were found during field survey. People are interested to promote, produce and marketing of the alternative to bricks. Motivation and support from the government and other sources required for entrepreneurship development.

Specific findings:

1. As per as disaster concern, both Gazipur and Dinajpur are vulnerable to earthquake. On the other hand, Khulna and Noakhali areas are more prone to strong wind of cyclone.
2. Overall awareness level in the community is low but some people are aware of durability, disaster resilient and professionalism.
3. CGI sheet, Clay brick, sand, cement, rod are the most common construction materials and concrete & masonry are the present practicing technologies.
4. Raw material sources for alternative products are available in Dinajpur and Khulna for concrete block and CSEB respectively but no source in Gazipur and Noakhali.
5. Prospect of micro-enterprise development is fair enough. Motivational work, guidelines and incentives will facilitate the increased rate of MEs.
6. As per as appropriate Construction Materials for Study Areas, findings are as below-
 - a. Dinajpur – Concrete block, CSEB and RHAB
 - b. Gazipur – Concrete block, CSEB and RHAB
 - c. Khulna – CSEB, RHAB
 - d. Noakhali – Concrete block and RHAB
7. Environment friendly construction block market is absent because of lack of entrepreneurs. More and more entrepreneurs in this sub-sector can pave the way of creating block market.
8. No training and skill development opportunity present in the study areas for the relevant professionals in the construction and building material sub-sector.
9. Soil test reveals that River bed sand from Dinajpur is suitable as raw materials for all sorts of blocks and ferrocement. On the other hand, soil from Gazipur and Khulna are suitable for Compressed Stabilized Earth Block (CSEB).
10. Area wise appropriate raw materials for block are as below-
 - a. Khanshama Dinajpur: river dredged sand, rice husk ash in small scale
 - b. Gazipur Sadar: river dredged fine sand and silt, rice husk ash in small scale
 - c. Khulna Sadar: river dredged silt and clay, rice husk ash in small scale
 - d. Begumgonj Noakhali: rice husk ash in small scale
11. Prospect of environment friendly construction block materials is very high.
12. As per as the certification and registration of MEs, mandatory licenses are Trade License, Tax Identification Number (TIN), VAT registration and Factory plan approval. Fire License requirement will follow Bangladesh National Building Code (BNBC). At present, there is no bar for marketing concrete block product without certification from BSTI. Public Works Department (PWD) has its standard for

Concrete blocks. It would be wise for MEs to follow PWD standard for getting access to premium market.

13. Major non-revenues generating physical activities are as below:
 - a. Structure for storage of raw materials such as cement, sand etc.
 - b. Structure for production plant
 - c. Waste dumping pit & Waste Management
 - d. Construction of office building fitted with furniture, computer, office equipment
 - e. Construction of shed and toilet for buyers and sellers
 - f. Sanitation system development for buyer and seller
 - g. Firefighting devices
14. Major revenue generating common services are as below:
 - a. Advertisement (billboards, posters, leaflets and flyers, sponsoring, etc.)
 - b. Branding (E-commerce platform for branding and Market Promotion)
 - c. Certification (BSTI, quality testing, etc.)
 - d. License, Training, Website development and maintenance
 - e. Instalment of routine testing facilities
 - f. Generator for emergency power for uninterrupted production
 - g. Pickup/Truck/Boat for block carrying
 - h. Solar Panel for common purpose electricity
 - i. Tools and instruments for machineries trouble shooting repairs

1.4 Conclusion:

Most of the IDIs, KIIs and FGDs contain a more or less common response from the field level, that is, the need for entrepreneurship development and job creation in order to successfully transfer the new technology and apply the same at a larger scale. This, in turn, necessitates providing fund support to the existing experienced micro enterprises for adopting the technology as sustainable business initiatives as well as for individual house owners who would potentially adopt and buy the new housing materials, that is the end clients. With this as the specific issue the findings do also point to the following important concerns:

- SDG Concern: Presently used building materials are not environment friendly so as to achieve sustainable development goals (SGDs) by 2030.
- Brick phasing out by 2025: Government policy is to phase out conventional clay burn brick by June 2025 and adopt alternative construction material to replace traditional brick.
- Raw material: All areas of Bangladesh do not have the same raw materials for alternative building blocks. Solution for production and usage of alternative raw materials will be different for different areas.
- Paradigm shift: Paradigm shift from conventional material and technology to environment friendly one will facilitate entrepreneurship development as well as employment generation.
- Women's Entrepreneurship: government policy is to provide loan at single digit interest to women which may encourage women entrepreneurs in the field of improved materials.
- Government Policy: Uses of environment friendly improved material in all public program for infrastructure development will facilitate the development of MEs in this sector.
- Market Strengthening: Though present brick market is not well structured, but it's possible to organize new block market in a structured way in line with demand and supply chain.

- Support on finance and technical know-how: Entrepreneurs need not only financial/credit support but technical knowhow, research and testing facilities which can be supported by the establishment of central common services/facilities.
- Selection of appropriate technology: It is important to select appropriate technology for improved material manufacturing/production. Appropriate technology includes appropriate tools & machineries, selection of suitable product type, design of suitable raw materials and mix.
- Skill development, testing and research: At the beginning of any sustainable entrepreneurship development program, it is important to include skill development, research and testing components.
- Quality Assurance of product: It is most important to ensure product quality through continuous quality auditing, quality control & quality management for sustainable trading and entering into premier market.
- Affordable price: Creating a market for improved materials and its sustainability will be largely dependent on affordable prices.
- Life Cycle Cost Analysis: Life Cycle Cost Analysis concept for housing and other structures need to be introduced.
- No national standard for environment friendly construction materials is available.

1.5 Recommendations:

General:

1. Integrated initiative required to develop Micro Entrepreneurship for manufacturing and marketing of alternative to clay brick.
2. Nationwide raw materials mapping of alternative construction materials is necessary.
3. National standard and specifications shall have to be developed for environment friendly building materials.
4. Awareness raising and orientation programs for the concern are required.
5. To orient and encourage local people as well as local government bodies to accept new technologies, it is required to undertake pilot programs on housing and road constructions using sustainable materials and technologies. Government, Development Partners, PKSF, INGOs or NGOs may take such initiatives.
6. It is necessary to provide incentives in the form of credit or leasing of khas land for the entrepreneurs will help promoting improved materials. Existing brick kiln owners might be potential stakeholders.
7. Advocacy programs for intervention on present practices of using clay burn bricks in all government projects including Ashrayon-2.
8. Both Micro Entrepreneurs (MEs) and the house builders should bring under credit facilities run by government and donors' initiatives;
9. Publishing Manuals and Handbook on block manufacturing and ferrocement technology and their process, technical specification, quality control and masonry work would play important role for promotion of alternative technologies.