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From local building practices to vulnerability reduction: building resilience through existing resources, knowledge and know-how

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Abstract

This paper presents an experience conducted in the framework of a disaster preparedness programme in Bangladesh, where the understanding of existing building culture and resources represents the starting point to develop vulnerability reduction strategies strongly rooted into local conditions and practices.

Bangladesh is a multi-hazard prone country. Based on lessons learnt from shelter response after 2007 and 2009 cyclones, a major Bangladeshi implementing agency jointly with a Bangladesh University and with the support of a foreign international agency, took the challenge to associate local communities, operational and academic stakeholders as well as linking emergency, rehabilitation and development. After a pilot phase, a 3-years programme has been undertaken at national level to develop strategies for habitat, risk reduction and disaster preparedness, on the basis of a strong participatory and interdisciplinary approach. This process started with the analysis of local houses, resources and coping practices in different regions of the country. From the findings, technical solutions have been elaborated, for each area, to improve existing buildings as well as to respond to future crisis, according to cultural, social, environmental and economical specificities of each site.

Past experiences on post-disaster response have highlighted the need for more context specific approaches, that do not focus only on effective and efficient built products but that directly contribute to a sustainable and long term vulnerability reduction and poverty reduction. In areas prone to recurrent natural hazards, local population and builders have often integrated these risks into their daily practices, developing in many cases particular behaviour, to reduce the vulnerability of the built environment. These coping strategies are usually a balance between existing skills, resources and risks and can be extremely valuable for the enhancement of local resilience.

Assessment alone is not enough to foster the development of affordable and sustainable solutions; awareness also needs to be developed. Starting from how we apply learning's to other projects at regional and national level, this paper will explore the contribution of the analysis of local building culture into vulnerability reduction strategies, linking past present and future of a community.

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Introduction

Bangladesh is one of the most disaster prone countries in the world due to its geographical location. Floods, cyclones, tidal surges, landslides, tornadoes, riverbank erosion, drought and earthquakes are very common hazards.

After any disaster, different agencies prepare different models of shelter responses (Low Cost Housing – LCH). Some are very costly and strong enough and some are very weak and temporary. After the construction of external agency led houses, it is rare the community is replicating the same design by themselves.

In the same time, given the large difference in existing risks and cultures, each community developed its specific local knowledge related to local risks, natural resources, people lifestyle and culture[*]. But these locally available solutions are generally not considered in re-construction projects[†].

This paper presents the learning of the past, ongoing and further phases of a programme that started in 1970 and is still ongoing in 2014. It has been implemented in various steps that helped to develop appropriate methodological approach to better served the most vulnerable population in Bangladesh.

These main phases are:

- From 1970 to 2008, experience accumulated through the production of 443 401 LCH
- Pilot project that was implemented between 2009 and 2010 in two hazard prone area in Bangladesh.
- Consolidation phase, which started in 2011 and is still on going, that aim to improve on the lessons learnt from the pilot project, and disseminate its results at the national level.

Nomenclature

A	Objective of the project
B	Project location
C	Project strategies
D	Project tools
E	Project sequences; participatory approach
F	Scientific assessment of the various concepts developed within the project
G	Key innovative aspects of the project
H	Main results (amongst many others)
I	Project effects and impact
J	References

[*] Pierotti, Ulivieri, 2001, p. 7; Rapoport, 1969; Segaud, Brun, Driant, 2002, p. vii ; Belmont, 1970, p. 24 : Rudofsky (1965); Oliver, 1997, p.ii;
[†] Boen, 2001; Boen, Pribadi, 2009; Commission Europeenne, 2001 ; Revet, 2008 ; (Davidson, Johnson, Lizarralde, et al., 2007

1. Objective of the project

The project simultaneously works on housing improvement, to reduce future risk, and on disaster preparedness by developing LCH (to be implemented after any disaster) that could evolve to more resilient houses. Aim is to take the best benefit from existing local resources, local building knowledge and practices, coping capacities, industrialized techniques and materials, to develop contextual answers for construction and reconstruction in disaster prone areas.

2. Project location

Bangladesh is a multi -hazard prone country where damage to housing is extremely high. Architectural typologies, construction techniques, lifestyles and risks considerably vary from region to region. Local people and builders have developed particular behavior, construction techniques and devices to reduce the vulnerability of the built environment but these coping strategies significantly differ, even within the same community, according to existing resources and capacities. Nevertheless, natural hazards associated with existing vulnerability often exceed people capacity to cope and manage crisis situations. Based on lessons learnt from 1970 to 2007, Caritas Bangladesh jointly with the Bangladesh University of Engineering and Technology (BUET) and CRAterre laboratory from the National School of Architecture of Grenoble have implemented a project to develop contextual solutions that fit with international standards and people needs and have better impact, both on the local economy and existing building practices. This project has been carried out through 3 different steps, from an external evaluation, allowing for a better adaptation of shelter models to existing practices, and a pilot phase in two hazard prone areas developing different approaches and shelter designs according to context specific issues, to a 3-year project, developing and disseminating specific disaster preparedness and shelter response strategies for each region with national coverage.

3. Project strategies

The project is implemented according to an iterative approach on the basis of complimentary activities- analysis, design, implementation, evaluation and dissemination- fostering greater project flexibility and partner's capacity building, through the involvement at all stages of local communities[‡], the implementing agency and the academic labs. The focus is on solutions that privilege the use of local resources both for construction, implementation and management to ensure maximum benefits from invested funds at local level. Furthermore the project pays a special attention to economic accessibility issues so that duplication is possible for a great number.

The project constructed specific models for all selected areas. Appropriate community led approach[§] were adopted all along the project in order to secure appropriateness of solution developed. The behaviour of all models has been scientifically assessed checked and certified by a well-recognized Bangladeshi engineering university.

Models included:

- Demonstration of improved Safer Houses[**]. The aim is to demonstrate the safer houses low income people can afford. Design takes benefit from the strength of existing local building culture, and includes technical improvement to answer identified weaknesses.

[‡] Abhas et al 2010 ; ARSHAD, RASHEED, 2011

[§] GRÜNEWALD, 2005

[**] JHA, DUYNE BARENSTEIN, PHELPS, ET AL., 2010, p. 225

- Disaster shelter response prototype. Designs are respecting Sphere standard, and fit with the targeted budget agreed amongst agencies involved in post disaster response. These shelters are core houses that can be improved to become *Safer House*. If not possible they are designed for its component to be reusable for final *Safer House.*
- A component on housing repair and improvement. Population is invited to visit and understand the project models. Then, a door to door assessment of beneficiaries' housing condition is done and a consensus with all stakeholders end decision on what will be done to help the beneficiaries' houses to be improved.

In order to ensure local capacity building regarding the whole project approach, activities have been implemented step by step, with first phase handled by international and national expertise, then an appropriation phase was handled by National and regional staff. Finally, a consolidation phase was implemented at level of local staff.

After completing the appropriation of methodological approach regarding assessment and community – led houses design, local and regional staff were asked to develop contingency plan to answer different disaster scale that may occur in concerned areas. Special focus was to help the proposed project budget to feed as much as possible the local economy. This included the need for manpower, material production and supply.

4. Project tools

Specific methodological approaches have been developed for the analysis of local building culture considering housing, context, resources, capacities and coping strategies. In each area, assessments have been conducted with strong population involvement in order to identify a variety of constructive and operational options to reduce vulnerability. Tools included criteria to consider for the analysis of local practices. Survey forms, have been developed in relation to various analysis levels: housing, context, resources and capacities. These aspects have been developed in the framework of a PhD thesis[††].

5. Project sequences; participatory approach

The project has been implemented in each area according to the following sequences:

5.1 Preliminary phase in each area where the project implanted activities

This included meeting with the community to share the project concept. Then, the project helps the community to form a Village Project Community. Last step was to go through a community-led beneficiary's selection for all type of physical activities to be implemented.

5.2 Survey implementation, assessment of local housing conditions as well as identification of strengths and weaknesses of local building practice

First step was to organize data collection on number of households and existing building typologies as well as about the village and its social, economic and natural environment. This was done on the basis of discussions with local communities. Through a transect walk, identification of the building typologies and the houses to be surveyed was achieved. During these surveys, data regarding social and cultural value, space distribution, were collected. Complementary meeting with local community and artisans was organized to collect data on building process, available resources, building materials, costs, existing skills and know-how. After analysis of all these data's, a debriefing with the local community about the finding was done in order to and integrate the necessary adjustments

[††] Caimi, A. 2014. *Cultures constructives vernaculaires et résilience. Entre savoir, pratique et technique: appréhender le vernaculaire en tant que génie du lieu et génie para sinistre*. Grenoble: Université de Grenoble.

5.3 Design of demonstration houses and of disaster shelter response

From the results of the previous step, a first design is developed and presented to the community for comments and validation. Project team revises the initial design and again, work with the community to achieve final design.

5.4 Construction of model demonstration house and of disaster shelter response

The construction of one model and prototype houses is use to train local artisans. This model serves also to have the feedback from community. Then, final design is achieved, followed by a second phase of construction and training.

5.5 Implementation of existing housing improvement activities

To disseminate local building good practice amongst the population, events are organized to help inhabitant to visit the demonstrations houses. They receive information regarding the reasons of each architectural design and technical details that can help to improve the houses safety. Then, project team and beneficiaries determine supports that will be given to each individual and physical technical improvement are implemented in beneficiary's houses. To receive feedback from inhabitant, a last community meeting is organized at the end of the construction.

6. Scientific assessment of the various concepts developed within the project

6.1 Design in Cyclone-prone Area

A four pitched roof is selected for better wind resistance. As per BNBC, 1993 the house should be designed for 260 km/h fastest mile. However, a realistic compromise on wind speed had been reached. Since these houses are vernacular in nature and cannot be treated as an engineered, these buildings cannot satisfy the building code requirements. A RC and timber framing system, which is common in the area, is chosen. For the post, 1:2:4 concrete post reinforced with mild steel bars is selected whereas timber from locally available rain tree is used for beams and roof rafters. Timber properties have been ascertained from laboratory testing. A stepped earth plinth is chosen for better protection. Two parts of bamboo fences were used for better maintenance/repair of the lower part fence. Bracings (especially corner bracings) were provided for better wind resistance.

Based on the considerations, a 3-D finite element analysis was conducted. FE analyses are conducted to estimate the wind resistance of such system. It shows that diagonal bracing would be better resistant to wind. However, finally due to construction difficulty, the diagonal bracings were changed to corner bracing.

6.2 Design in Flood Prone Area and River Bank

A two pitched roof is selected in the flood-prone area where normal wind resistance is needed (i.e. lesser than cyclone prone area). A RC and timber framing system, which is common in the area, is chosen. For the post, 1:2:4 concrete post reinforced with mild steel bars is selected whereas timber from locally available rain tree or Mehagani is used for beams and roof rafters. Timber properties have been ascertained from laboratory testing. A stepped high earth plinth is chosen for better protection as the area is flood prone. Two parts of the bamboo fences are considered for better maintenance/repair of the lower part fence. A loft is provided to save valuables during flood.

Based on the design considerations, a 3-D finite element analysis was conducted. Although in the regions near or on the bank of the river, flooding is a common problem, river bank erosion causes shifting of houses (based on local practice identified during the assessment of local practice). Also different types of '*katla*'(which provides joint between the post and foundation) have been used to see their performances. Stepped footing and three part fencing have been used in the design for better protection against rain-cut erosion.

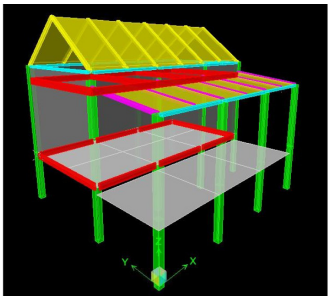

Figure 1. 3-D finite element analysis

Figure 2. House studied in the 3-D finite element analysis

7. Key innovative aspects of the project

7.1 Learning from the existing local building culture and valuing existing communities' best practices

To fully integrate local resources (human and materials), the project integrated the following principle:

- Put the local populations at the centre of the whole project: adopt a participatory approach, support the bearers of local knowledge and know-how, strengthen social ties, thus enable a return of individual dignity
- Identify local know-how and methods of organization, adaptation and housing protection strategies, and integrate these elements in the development of the programs to be implemented
- Implement the project through an iterative approach, from pilot projects, consolidation phase then, dissemination, including regular monitoring and evaluation. This helped to adjust methodological approach, strategies and architectural design at all steps of the project
- Construct demonstration prototypes, then apply proposed solution at small scale, in order to achieve local and national awareness regarding the potential of local materials for building quality housing
- Pay attention to economic accessibility issues, so that duplication is possible for a great number

7.2 To link tradition and modernity:

Local building culture is a continuous evolving process. Changes in the society, in the environment, in the availability of new technologies (awareness, physical access, economical access…), are a chance for inhabitant to improve on the existing. But special care should be taken in order to avoid low-quality imitations or ill-calculated technological adaptations with a low resistance to natural hazards, inferior compared to fully local options. The project helps local population to understand the value of their local culture, then to prioritize housing improvement according to their technical and financial capacities as well as the potential of the local environment.

7.3 To design post disaster project as a support for poverty alleviation

The building industry is a sector with high potential for local and national economies, as long as employment and qualification strategy is considered from the beginning. There is a tendency, at international level, to consider that high-tech and industrial solutions have to be promoted. It results in the fact that money invested often "by pass" local communities or has a very limited impact on them. Our project privilege the use of local resources for raw material, craftsmen, and management, and if not locally available, research and development, training, etc., were developed to fill existing gaps and ensure that the funds invested have a maximum impact on the local economy.

7.4 To link action, research and education.

Today, worldwide, there are great threats for evacuating the techno-diversity, for imposing more, and much more, uniformity. Conserving the memory of the building cultures might be a way to found concrete hopes for the

transmission of the techno-diversity to present and future generations. In Bangladesh, about 83% people live in house built without the support of any architect and/or engineer. The educational institutions have big establishment/study areas for the architectural and structural design of buildings/constructions but there is no establishment/study area for this sector, so far, the average research rate in this field is only 3%. A large gap exists between technical knowledge developed and taught in the universities and building practices implemented by the majority of the people. The project involved Universities, to benefit from their support, and also to help them to acquire experience in local building culture. In the future, through lecture, internships, etc., they will help their students to a better exposure to these issues, and so, they will develop a better capacity to answer such challenges.

7.5 To link emergency, rehabilitation, development, risk reduction and disaster preparedness

There is a need to work simultaneously on housing improvement, aiming at reduce future risk, and to work on disaster preparedness by developing disaster response that will be core houses of source of material that could help local population to access to safer houses.

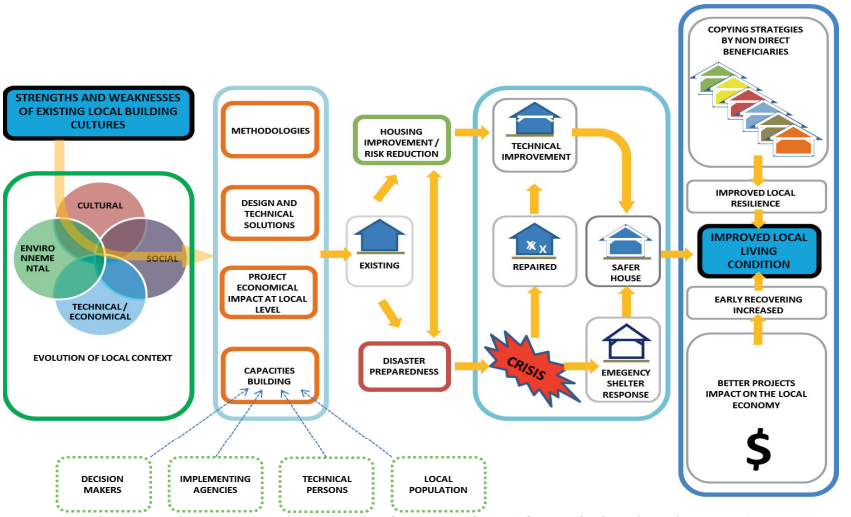

Figure 3. The conceptual approach of LCH project (after Caimi and Moles, 2014)

8. Main results

The project approach helped to better address contextual people needs. For example, is has been assessed that, in the same location, options can be given to the local population to fit with their particular culture.

In Dinajpur area, project develops models that will allow the house to be dismantled in very little delay, adopting in this regards existing local practise.

Figure 4. Site subject to erosion

Figure 5. Solution easy to dismantle

Figure 6. Solution easy to dismantle

In Bandarban area, the project design two disaster models, at the same cost, and, in case of crisis, will let beneficiaries decide on the one they will choose for themselves.

Figure 7. Bandarban, “machan model”

Figure 8. Bandarban, “on the ground model”

In Khulna area, due to excessive hit in hot season, and to help to increase impact in the local economy, the project shift from zinc roof to clay tile roofing material.

Figure 9. Kulna, locally produced clay tile

Figure 10. Kulna, model house

Project effects and impact

The project partners convince others funding agencies to adopt project approach to implement their own housing programme. Since 2011, more than 1 085 LCH developed following the project approach were constructed. In the same time, the project impacted at the level of national policy regarding post disaster response. The Bangladeshi Shelter Cluster adopted some of the projects basics technical principle as a rule for disaster housing response. An otehr very interesting project effect is the fact that dedicated lecture on the topic of vernaculars architectures are delivered at the level of the university. In 2014, 250 students were exposed to these issues.

Since 2011, the project methodology has been applied in other contexts (Haïti, Nigeria, Benin, the Philippines…), and endorsed by others implementing agencies (Caritas Philippines, FICR, UN Habitat…).

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